**SECTION 33 47 16**

GEOMEMBRANE COVER USING WOVEN COATED POLYETHYLENE

PART 1 GENERAL

* 1. SCOPE

The scope of work covered by this specification is for the manufacture, supply, and installation of a [12 | 16 | 20 | 24] mil Woven Coated Polyethylene (WCPE) for Geomembrane Cover applications.

* 1. REFERENCES
1. ASTM International
	1. D 751 Standard Test Methods for Coated Fabrics
	2. D 4218 Standard Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique
	3. D 4355 Standard Test Method for Trapezoid Tearing Strength of Geotextiles
	4. D 4833 Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products
	5. D 5261 Standard Test Method for Measuring Mass per Unit Area of Geotextiles
	6. D 7747 Standard Test Method for Determining Integrity of Seams Produced Using Thermo-Fusion Methods for Reinforced Geomembranes by the Strip Tensile Method
	7. E 96 Standard Test Methods for Water Vapor Transmission of Materials
	8. G 154 Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials
	9. SUBMITTALS
2. The WCPE geomembrane cover manufacturer shall provide the owner / engineer a certificate stating the name of the WCPE geomembrane cover manufacturer, product name, style, polymer composition, and other pertinent information to fully describe the geomembrane.
3. The WCPE geomembrane cover manufacturer shall provide the owner / engineer with a copy of quality control certificates issued by the resin supplier that resin meets the specifications, and that no recycled polymer is included within the resin.
4. The WCPE geomembrane cover manufacturer is responsible for establishing and maintaining a Quality Control Program to assure compliance with the requirements of the specification. Documentation describing the quality control program shall be made available to the owner / engineer prior to the approval of the WCPE geomembrane cover for use on the project.
5. The WCPE geomembrane cover manufacturer shall provide the owner / engineer with a Certificate of Compliance (COC) stating that the furnished WCPE geomembrane cover meets requirements of the specification as evaluated under the manufacturer’s quality control program. The certificate shall be attested to by a person having legal authority to bind the Manufacturer.
6. The WCPE geomembrane cover manufacturer shall provide the owner / engineer with a sample warranty, covering defects and workmanship of the WCPE geomembrane cover material.
	1. QUALIFICATIONS
7. Manufacturer
	1. The specified WCPE geomembrane cover shall be manufactured by:
		1. Owens Corning

One Owens Corning Parkway

Toledo, OH 43659

* + 1. An equivalent manufacturer as specified by the owner / engineer
	1. Any equivalent manufacturer of the WCPE geomembrane cover specified shall have at least five (5) years of continuous experience in the manufacture of such geomembrane. Equivalent manufacturer shall have produced at least 5,000,000 square feet of the specified type of geomembrane over the last five (5) years. The equivalent manufacturer shall provide the owner / engineer with documentation of such.
1. Fabricator (if applicable)
	1. The fabricator shall be a company approved by the manufacturer, or specializing in the fabrication of reinforced polyethylene geomembranes. The fabricator shall have at least five (5) years of continuous experience in the fabrication of such geomembrane. Fabricator shall have fabricated at least 5,000,000 square feet of the specified type of geomembrane over the last five (5) years. The fabricator shall provide the owner / engineer with documentation of such.
2. Installer
	1. The installer shall be the fabricator, approved fabricator's installer, or an installer/contractor approved by the owner, or the manufacturer on behalf of the owner. The installer shall have at least five (5) years of continuous experience in the installation of such geomembrane. The installer shall have installed at least 5,000,000 square feet of the specified type of geomembrane over the last five (5) years. The fabricator shall provide the owner / engineer with documentation of such.
	2. LABELING, DELIVERY, STORAGE, AND HANDLING
3. Each roll and/or panel of WCPE geomembrane cover shall be delivered to the site with appropriate labeling, to include:
	1. Original Manufacturer’s Name
	2. Fabricator’s Name (if applicable)
	3. Product Identification
	4. Date of Production and/or Fabrication (if applicable)
	5. Material Thickness
	6. Roll Length, Width, and Gross Weight
	7. Roll Number (or Panel Number, if fabricated)
	8. Instructions on Deployment Orientation / Direction (if fabricated)

Any WCPE geomembrane cover roll and/or panel delivered to the site without all of the labeling described above shall be rejected by the owner / engineer and /or installer

1. Each roll and/or panel of WCPE geomembrane cover shall be delivered to the site by appropriate means to prevent damage to the material and facilitate off-loading.
2. Off-loading and storage of the WCPE geomembrane cover is the responsibility of the installer. Any damage caused or observed during off-loading shall be immediately reported to the owner / engineer.
3. All damaged rolls must be separated from the undamaged rolls until the proper disposition of that material has been determined by the owner / engineer, who will be the final authority on determination of damage.
4. The WCPE geomembrane cover shall be stored so as to be protected from puncture, dirt, grease, water, moisture, mud, mechanical abrasions, excessive heat, or other damage. A sacrificial cover must be used to protect the WCPE geomembrane cover if stored on site more than six (6) months. The rolls shall be stored in such a manner as to avoid shifting, abrasion, or other adverse movements that can damage the material.
5. The rolls shall be stored on a prepared surface (not wooden pallets) and should not be stacked more than three rolls high.
6. WCPE geomembrane cover shall be transported on the site with spreader bars and slings, or other equipment that prevents potential damage to the rolls or panels.
	1. WARRANTIES
7. The WCPE geomembrane cover manufacturer shall provide a written warranty directly to the owner, which warrants that the [ 12 | 16 | 20 | 24 ] mil WCPE geomembrane cover is free from defects in materials and/or workmanship for a period of [ 1.5 | 2 | 2.5 | 10 ] years in exposed applications.
8. The manufacturer’s warranty applies only to material defects, and does not cover welding or seaming, or any damages to the WCPE geomembrane cover once it has been delivered to the fabricator (if applicable) and/or the installer.

PART 2 PRODUCTS

1. GEOMEMBRANE MATERIAL
2. The Basis of Design shall be the RhinoSkin™ [ 12 | 16 | 20 | 24 ] Woven Coated Polyethylene geomembrane manufactured by Owens Corning.
3. Any substitutions or variations from the Basis of Design shall be an equivalent product, requiring express written approval from the engineer of record on the project.
4. GEOMEMBRANE PROPERTIES [ choose one material ]

The [ 12 ] mil WCPE geomembrane cover shall have the following properties:

|  |  |  |
| --- | --- | --- |
| PROPERTY | TEST METHOD | TYPICAL VALUE1 |
| Weight | ASTM D5261 | 5.7 oz./yd2 |
| Thickness | ASTM D751 | 12 mil |
| Strip Tensile Strength (MD) | ASTM D751 | 170 lbf |
| Strip Tensile Strength (CD) | ASTM D751 | 120 lbf |
| Strip Tensile Elongation (MD) | ASTM D7003 | 20% |
| Strip Tensile Elongation (CD) | ASTM D7003 | 20% |
| Index Puncture Resistance | ASTM D4833 | 100 lbf |
| Trapezoidal Tear (MD) | ASTM D4533 | 65 lbf |
| Trapezoidal Tear (CD) | ASTM D4533 | 40 lbf |
| Carbon Black Content | ASTM D4218 | > 2% |
| Accelerated UV Weathering2 | ASTM G154 | > 90% @ 2,000 hrs. |

Notes:

1 Typical values represent an average test result for the sample size, with + 10% variance

2 Test valued based on A-340 lamps, 8 hours UV @ 60° C, 4 hours condensation @ 40° C

The [ 16 ] mil WCPE geomembrane cover shall have the following properties:

|  |  |  |
| --- | --- | --- |
| PROPERTY | TEST METHOD | TYPICAL VALUE1 |
| Weight | ASTM D5261 | 7.2 oz./yd2 |
| Thickness | ASTM D751 | 16 mil |
| Strip Tensile Strength (MD) | ASTM D751 | 270 lbf |
| Strip Tensile Strength (CD) | ASTM D751 | 230 lbf |
| Strip Tensile Elongation (MD) | ASTM D7003 | 20% |
| Strip Tensile Elongation (CD) | ASTM D7003 | 20% |
| Index Puncture Resistance | ASTM D4833 | 130 lbf |
| Trapezoidal Tear (MD) | ASTM D4533 | 68 lbf |
| Trapezoidal Tear (CD) | ASTM D4533 | 50 lbf |
| Hydraulic Conductivity | ASTM E96 (‘B’) | 2.0 x 10-11 cm/sec |
| Carbon Black Content | ASTM D4218 | > 2% |
| Accelerated UV Weathering2 | ASTM G154 | > 90% @ 2,000 hrs. |

Notes:

1 Typical values represent an average test result for the sample size, with + 10% variance

2 Test valued based on A-340 lamps, 8 hours UV @ 60° C, 4 hours condensation @ 40° C

The [ 20 ] mil WCPE geomembrane cover shall have the following properties:

|  |  |  |
| --- | --- | --- |
| PROPERTY | TEST METHOD | TYPICAL VALUE1 |
| Weight | ASTM D5261 | 9.6 oz./yd2 |
| Thickness | ASTM D751 | 20 mil |
| Strip Tensile Strength (MD) | ASTM D751 | 305 lbf |
| Strip Tensile Strength (CD) | ASTM D751 | 300 lbf |
| Strip Tensile Elongation (MD) | ASTM D7003 | 20% |
| Strip Tensile Elongation (CD) | ASTM D7003 | 20% |
| Index Puncture Resistance | ASTM D4833 | 150 lbf |
| Trapezoidal Tear (MD) | ASTM D4533 | 75 lbf |
| Trapezoidal Tear (CD) | ASTM D4533 | 60 lbf |
| Hydraulic Conductivity | ASTM E96 (‘B’) | 1.5 x 10-11 cm/sec |
| Carbon Black Content | ASTM D4218 | > 2% |
| Accelerated UV Weathering2 | ASTM G154 | > 90% @ 2,000 hrs. |

Notes:

1 Typical values represent an average test result for the sample size, with + 10% variance

2 Test valued based on A-340 lamps, 8 hours UV @ 60° C, 4 hours condensation @ 40° C

The [ 24 ] mil WCPE geomembrane cover shall have the following properties:

|  |  |  |
| --- | --- | --- |
| PROPERTY | TEST METHOD | TYPICAL VALUE1 |
| Weight | ASTM D5261 | 11.5 oz./yd2 |
| Thickness | ASTM D751 | 24 mil |
| Strip Tensile Strength (MD) | ASTM D751 | 350 lbf |
| Strip Tensile Strength (CD) | ASTM D751 | 305 lbf |
| Strip Tensile Elongation (MD) | ASTM D7003 | 20% |
| Strip Tensile Elongation (CD) | ASTM D7003 | 20% |
| Index Puncture Resistance | ASTM D4833 | 175 lbf |
| Trapezoidal Tear (MD) | ASTM D4533 | 85 lbf |
| Trapezoidal Tear (CD) | ASTM D4533 | 63 lbf |
| Hydraulic Conductivity | ASTM E96 (‘B’) | 1.0 x 10-11 cm/sec |
| Carbon Black Content | ASTM D4218 | > 2% |
| Accelerated UV Weathering2 | ASTM G154 | > 90% @ 2,000 hrs. |

Notes:

1 Typical values represent an average test result for the sample size, with + 10% variance

2 Test valued based on A-340 lamps, 8 hours UV @ 60° C, 4 hours condensation @ 40° C

1. OTHER PRODUCTS
2. Any tape used on the WCPE geomembrane cover shall be GeoLap™ Adhesive Roll manufactured by Owens Corning, or approved equal. Tape shall not be used for any primary welding / seaming unless express written permission is provided by the engineer of record to the fabricator and/or installer.

PART 3 EXECUTION

1. VERIFICATION
2. The area to be covered with WCPE geomembrane cover must be depicted on a drawing provided by the owner. This drawing should provide information regarding the coverage area location, dimensions, and any special provisions for the installation of geomembrane materials. The installer shall have this drawing readily available on the site at all times.
3. It is recommended that WCPE geomembrane cover be fabricated in a controlled environment prior to delivery to the site. Fabrication can result in higher quality seams by minimizing field seaming in adverse conditions. Fabrication can also save time and labor through creation of large panels that can be deployed on site with minimal field seaming.
4. SURFACE PREPARATION
5. Prior to WCPE geomembrane cover installation, the surface shall be prepared by grading and smoothing any cover soil to the specifications of the project construction documents.
6. No standing water, mud, vegetation, snow, frozen subgrade, or excessive moisture is allowed during WCPE geomembrane cover placement.
7. When applicable, an anchor trench, excavated in accordance with the approved construction documents, should be used as a perimeter termination point for the WCPE geomembrane cover. Installation of the WCPE geomembrane cover shall be started from the anchor trench.
8. GEOMEMBRANE DEPLOYMENT AND PLACEMENT
9. The WCPE geomembrane cover shall be installed to the limits shown on the engineering drawing and/or approved panel diagram.
10. No WCPE geomembrane cover material shall be unrolled and deployed if the sheet temperatures are lower than 32°F unless otherwise approved by the engineer.
11. Typically, only the quantity of WCPE geomembrane cover (rolls or panels) that will be properly anchored, ballasted and welded together in one day should be deployed.
12. The edges of the WCPE geomembrane cover shall be placed in an anchor trench as shown on the drawing. All anchor trenches shall be a minimum of 12 inches in width and depth, and be backfilled with compacted soil.
13. Sand bags or equivalent ballast shall be used as necessary to hold the WCPE geomembrane cover material in position under the average seasonal wind conditions.
	1. Sand bag material shall be sufficient to resist UV degradation for the duration of the cover service life.
	2. Sandbags should weigh approximately 40 pounds when filled
	3. Sandbags should be placed in accordance with wind uplift resistance designs / calculations provided by the owner, but spaced no greater than 8 feet in any direction
	4. All sandbags must be connected to each other using minimum ¾ inch thick polypropylene rope material with an average strength of 5,800 pounds. Any deviation must be approved by the owner.
14. In lieu of sandbag ballast, earth anchors approved by the WCPE geomembrane cover manufacturer can be used.
	1. Earth anchors must be 3/16” (min.) diameter steel wire, with helical twist and integrated top coil. The Basis of Design shall be the TL-TA-2 Twist Anchor manufactured by Gripple, Inc. Any substitutions or variations from the Basis of Design shall be an equivalent product, requiring express written approval from WCPE geomembrane cover manufacturer.
	2. Earth anchors must be designed for length and spacing based on wind uplift resistance designs / calculations provided by the owner.
	3. Earth anchors must be installed in accordance with the manufacturer’s recommended installation guidelines.
15. WCPE geomembrane cover placement shall not be done if moisture prevents proper subgrade preparation, roll / panel placement, or welding.
16. Fabricated WCPE geomembrane cover panels should be placed in accordance with the drawings, at a starting point on one corner of the area to be covered.
17. WCPE geomembrane cover that has not been fabricated must be deployed in individual rolls.
	1. Rolls should be suspended from a spreader bar and pulled in the direction of deployment, or they can be unrolled manually by holding the roll end and deploying the bulk roll.
18. GEOMEMBRANE SEAMING
19. [16 | 20 | 24] mil WCPE geomembrane cover can be seamed using a single-track thermal fusion wedge welder configured with solid rubber rollers and a minimum of 2-inch-wide solid wedge

OR

[12] mil WCPE geomembrane cover can be seamed with a “J” stitch using a hand-held geotextile sewing machine, and secured using GeoLap™ Adhesive Roll manufactured by Owens Corning, or approved equal.

1. Seaming is to be undertaken only by persons that have been trained and qualified in the use of the equipment. It is required that all equipment be setup to the standards of the manufacturer by a trained operator.
2. Prior to performing any seaming operation, ensure both WCPE geomembrane cover sheets are clean and dry at the interface, using clean, soft rags no more than 30 minutes prior to the seaming. The wedge should be cleaned and clear of any residual material buildup from previous use.
3. Set correct overlap through placement of adjacent WCPE geomembrane cover sheets or panels. The overlap should be between 4-6 inches to prevent wrinkles/bunching and ensure a full width seal will occur along the length of the seam.
4. Prior to any seaming of WCPE geomembrane cover, a trial seam process should be successfully completed. This ensures that the equipment is in proper working order, and that settings are sufficient for quality seams.
5. Trial seams should be performed on scraps of WCPE geomembrane cover that are no less than 4 feet long and at least 12 inches wide. Trial seaming should be performed in the same manner and conditions as anticipated field seaming.
6. Once the trial seam is complete, a total of Six (6) test specimens of 1” wide should be extracted from the last 12 inches of the weld. Three (3) specimens are to be used for shear testing, and the other three (3) used for peel testing in accordance with ASTM D7747, Method ‘A’. Testing should be performed by the installer (or fabricator) using a field tensiometer with a valid calibration performed no more than one year prior to the testing. Trial seam specimens should have peel and shear strength values no less than: [ choose one ]

10 lbf (peel) and 50 lbf (shear) [ 24 mil ]

8 lbf (peel) and 40 lbf (shear) [ 20 mil ]

6 lbf (peel) and 30 lbf (shear) [ 16 mil ]

4 lbf (peel) and 20 lbf (shear) [ 12 mil ]

1. If more than one (1) specimen in each testing group (shear and peel) does not meet or exceed the values shown above, then the machine should be inspected, settings adjusted, and the trial seam performed and tested again. If specimens do not pass after a third (3rd) trial, then the machine used to perform the trial seam must be taken out of operation, inspected, and repaired before being used again.
2. The operator must visually inspect the seam exiting the machine to ensure that the seam is even, without sharp edge lines. Visual detection of an asymmetric profile is in indication that the equipment needs adjusting before any further use.
3. Holes, rips, or tears in the WCPE geomembrane cover must be repaired.
	1. Holes, rips, or tears with jagged edges, less than approximately 0.5 inches in width or diameter can be repaired using GeoLap™ Adhesive Roll manufactured by Owens Corning, or approved equal over the damaged area.
	2. For holes, rips, or tears with jagged edges, exceeding approximately 0.5 inches in width or diameter, a clean extraction of material extending at least six (6) inches from the edge of the hole or defect should be removed. A repair patch using the same material should then extend a minimum of six (6) inches in all directions beyond the edge of the extraction, and secured using GeoLap™ Adhesive Roll manufactured by Owens Corning, or approved equal over the patch edges.
4. QUALITY ASSURANCE / QUALITY CONTROL
5. Panels and seams should be visually inspected by the installer (and/or fabricator) during and after all panel or roll deployment to identify defects, holes, blisters, or subgrade protrusions. Suspect locations, whether on a seam or the cover, shall be marked and repaired using the procedure described above.
6. On completion of installation, excess material shall be cut from the anchor trench areas and all scrap and debris shall be removed. The installer shall dispose of all waste and scrap material in a location provided and approved by the owner. No scrap material shall be left on the completed surface of the WCPE geomembrane cover.
7. The installer should remove all equipment used in connection with the work herein, and shall leave the premises in a neat and acceptable manner.
8. The installer, owner / engineer, and other participating representatives shall conduct a thorough walk through and visual inspection of the complete WCPE geomembrane cover surface, checking for any remaining defects requiring additional repairs.

\*\*\* END OF SECTION \*\*\*