

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials and installation of geomembranes for use in waste water ponds, sewage lagoons, landfill and other containment structures as an impermeable membrane.

1.2 MEASUREMENT PROCEDURES

- .1 Geomembranes will be measured in square metres of surface covered by material. No allowance will be made for seams and overlaps.

1.3 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
- .2 ASTM D5261, 5890, 4643, 5993, 4632, 5084, 5887, 5321.

1.4 SUBMITTALS

- .1 Submit to Engineer following samples at least 4 weeks prior to beginning Work. And in accordance with Section 01 33 00 – Submittal Procedures
- .2 Submit shop drawings in accordance with engineering procedures.
- .3 Indicate installation layout, dimensions and details, including fabricated and field seams, anchor trenches and protrusion details.

1.5 CERTIFICATES

- .1 Submit to Engineer copies of manufacturer's mill test data at least 4 weeks prior to start of work.
- .2 Submit to Engineer certificates, including test results, at least 2 weeks prior to delivery to job site.

Part 2 Products

2.1 MATERIALS

- .1 Geosynthetic clay liner (thermal lock geosynthetic clay liner, non woven or equivalent).

Thermal Lock (NWL) Geosynthetic Clay Liner or equivalent.

- .1 The Thermal Lock “NWL” is a needlepunch reinforced GCL comprised of a uniform layer of granular sodium bentonite encapsulated between a scrim reinforced nonwoven and a virgin staple fibre nonwoven geotextile. The needlepunched fibres are thermally fused to the scrim reinforced nonwoven geotextile to enhance the reinforcing bond.

Geotextile Properties	Test Method	Minimum Test Frequency	Value – English -	Value – SI -
Cap Nonwoven -1 Mass/Unit Area	ASTM D 5261	1/200,000 sq.ft. (1/20,000 sq.m.)	6.0 oz/yd ² MARV	200 g/m ² MARV
Scrim Nonwoven -2 Mass/Unit Area	ASTM D 5261	1/200,000 sq.ft. (1/20,000 sq.m.)	6.0 oz/yd ² MARV	200 g/m ² MARV
Bentonite Properties				
Swell Index	ASTM D 5890	1/100,000 lbs (50,000 kg)	24 ml/2g Min	24 ml/2g Min
Moisture Content	ASTM D 4643	1/100,000 lbs (50,000 kg)	12% max.	12% max.
Fluid Loss	ASTM D 5891	1/100,000 lbs (50,000 kg)	18 ml max.	18 ml max.
Finished GCL Properties				
Bentonite Mass per Unit Area ¹	ASTM D 5993	1/40,000 sq.ft. (1/4,000 sq.m.)	0.75 lbs/sq. ft. MARV	3.66 kg/m ² MARV
Grab Strength ²	ASTM D 4632	1/40,000 sq.ft. (1/4,000 sq.m.)	150 lbs MARV	667 N MARV
Grab Elongation ²	ASTM D 4632	1/40,000 sq.ft. (1/4,000 sq.m.)	150% Typical	150% Typical
Peel Strength ³	ASTM D 4632	1/40,000 sq.ft. (1/4,000 sq.m.)	15 lbs min.	66 N
Permeability ⁴	ASTM D 5084	1/100,000 sq.ft. (1/10,000 sq.m.)	5 x 10 ⁻⁹ cm/sec max	5 x 10 ⁻⁹ cm/sec max
Index Flux ⁴	ASTM D 5887	1/Week	1 x 10 ⁻⁸ m ³ /m ² /sec max	1 x 10 ⁻⁸ m ³ /m ² /sec max
Internal Shear Strength ⁵	ASTM D 6243	Periodic	500 psf Typical	24 kPa Typical
Dimensions				
Width x Length	Nominal	Every Roll	15.5 x 150 ft.	4.7 x 45.72 m
Area per Roll	Nominal	Every Roll	2325 sq.ft.	216 sq.m.
Packaged Weight	Typical	Every Roll	2500 lbs	1179 kg

1. Oven-dried measurement. Equates to 0.84 lbs when indexed to 12% moisture content.
2. Measured at maximum peak in the weakest principal direction.
3. Modified to use a 4 inch wide grip. The maximum peak of five specimens averaged.
4. De-Aired Tap Water @ 5 psi maximum effective confining stress and 2 psi head.
5. Typical peak value for specimen hydrated to 24 hr. and sheared under a 200 psi normal stress.

- .2 The GCL shall be manufactured by mechanically bonding the geotextiles using a needlepunching process to enhance frictional and internal shear strength characteristics. In order to maintain these characteristics, no glues, adhesives or other non-mechanical bonding processes shall be used in lieu of the needlepunch process.
 - .3 The Contractor must present a quality control plan to the Engineer before undertaking any work related to the geosynthetic clay liner.
- .2 Flexible Lining
- .1 Place compacted layer of granular material in unfrozen condition on bottom and sides of lagoon as indicated.
 - .2 Check surface on which flexible liner is to be placed and remove projections that may puncture lining.
 - .3 Place liner panels as directed by the manufacturer. Anchor panels temporarily using sand bags or other weights that will not damage liner. A supervisor from the manufacturer must be present during the procedure to approve the installation.
 - .4 Excavate anchor trenches at locations as indicated.
 - .5 Place and secure liner in anchor trenches.
 - .6 Backfill and compact anchor trenches.
 - .7 Clean edges of panels to be spliced and join as outlined in the manufacturer's recommendations.
 - .8 Complete anchoring of panels at base of slope.
 - .9 Cut liner sheets to fit accurately around inlets, outlets, sleeves, concrete structures and other projections through lining.
 - .10 Complete flashing and sealing of penetrations as indicated.
 - .11 Place cover blanket as indicated.
 - .12 Flexible lining handling and placement:
 - .1 Shipping and Handling Equipment – The party responsible for unloading the GCL shall contact the manufacturer prior to shipment to determine the correct unloading methods and equipment if different from the pre-approved and specified methods.
 - .2 The GCL must be supported during handling to ensure worker safety and prevent damage to the liner. Under no circumstances should the rolls be dragged, lifted from one end, lifted with only the forks of a lift truck or pushed to the ground from the delivery vehicle.
 - .3 The QCA inspector shall verify that proper handling equipment exists which does not pose any danger to installation personnel or risk of damage or deformation to the liner material itself.
 - .4 Roll Identification and Labelling – Prior to shipment, the manufacturer shall label each roll, both on the GCL roll and on the surface of the plastic protective sleeve. Labels shall be resistant to fading and moisture degradation to ensure legibility at the time of the installation. At a minimum the roll labels shall identify the following:
 - .1 Length and width of roll
 - .2 Total weight of roll

- .3 Type of GCL material
- .4 Production Lot Number and Individual Roll Number
- .13 Storage/Stockpiling/Staging
 - .1 Storage of the GCL rolls shall be the responsibility of the installer or other designated party. All GCL rolls shall be stockpiled and maintained dry, in a flat location area, away from high-traffic areas but sufficiently close to the active work area to minimize handling.
 - .2 For needlepunched GCLs, the presence of free-flowing water within the packaging shall require that the roll be set aside for further examination to ascertain the extent of damage, if any. Free-flowing water within the packaging of unreinforced GCLs shall be cause for rejection of that roll.
 - .3 GCL should be stored no higher than three to four rolls high or limited to the height at which the handling apparatus may be safely handled by installation personnel. Stacks or tiers of rolls should be situated in a manner that prevents sliding or rolling by “choking” the bottom layer of rolls.
 - .4 Rolls shall not be stacked on uneven or discontinuous surfaces in order to prevent bending, deformation, and damage to the GCL or cause difficulty inserting the core pipe.
 - .5 An additional tarpaulin or plastic sheet shall be used over the stacked rolls to provide extra protection for GCL material stored outdoors.
 - .6 Bagged bentonite material shall be stored and tarped next to GCL rolls unless other more protective measures are available. Bags shall be stored on pallets or other suitably dry surfaces which will prevent undue prehydration.
- .14 GCL Placement
 - .1 GCL Material shall be placed in general accordance with the procedures specified below and the manufacturer’s specifications, or modified to account for site specific conditions.
 - .2 GCL Orientation – GCL Panels shall be placed with nonwoven side up on slopes.
 - .3 GCL Panel Position – All slope panels shall be installed parallel to the maximum slope.
 - .4 Seaming – A 9-inch lap line and a 12-inch match line shall be imprinted on both edges of the upper geotextile component of the GCL to assist in installation overlap quality control. Lines shall be printed as continuous dashes in easily observable non-toxic ink.
 - .1 Overlap seams shall be a minimum of twelve inches on panel edges and twenty four inches on panel ends.
 - .2 Loose granular bentonite should be placed between panels at a rate of ¼ pound per lineal foot of seam if the GCL is the primary hydraulic seal.
 - .3 The addition of bentonite to the seam area is optional when the GCL will be acting as a leak isolator for an overlying FML.
 - .5 Detailing – Detail work, defined as the sealing of the liner to pipe penetrations, foundation walls, drainage structures, spillways, and other

appurtenances, shall be performed as recommended by the GCL Manufacturer.

- .6 Damage Repair – Prior to cover material replacement, damage to the GCL shall be identified and repaired by the installer. Damage is defined as any rips or tears in the geotextiles, delamination of geotextiles or a displaced panel.
- .7 Stop GCL installation work when it rains. The GCL must be covered before the rain starts. Personnel or equipment must not circulate directly on the GCL when it rains.

.15 Covering Materials

- .1 Covering materials shall be compatible, as well as suitable, for use over the GCL, and placed in a manner appropriate to the particular subgrade. Regardless of the covering material, the uncovered edge of GCL panels shall be protected at the end of the working day with a waterproof sheet which is secured adequately with ballasts.

2.2 Material Warranty

- .1 Provide the Owner with a written warranty against manufacturing defects for a period of twenty (20) years from the date of installation.

2.3 Guarantee

- .1 Provide the Owner with a written guarantee against defects in installation and workmanship for a period of five (5) years from the date of final acceptance, at no cost to the Owner.

Part 3 Execution

3.1 CLEANING

- .1 Remove construction debris from Project site and dispose of debris in an environmentally responsible and legal manner.

3.2 PROTECTION

- .1 Do not permit vehicular traffic directly on membrane.

END OF SECTION