

CONSTRUCTION SPECIFICATION

425B. HIGH DENSITY POLYETHYLENE GEOMEMBRANE

1. SCOPE

This work shall consist of furnishing all materials and equipment and labor necessary for installation of high-density polyethylene (HDPE) geomembrane liners.

2. QUALITY

Geomembranes shall conform to the requirements of Table 1.

TABLE 1 - PROPERTIES OF HDPE GEOMEMBRANES

<u>TEST DESCRIPTION</u>	<u>TEST METHOD</u>	
Thickness – mils (nominal)	ASTM D-1593	40
Specific Gravity – minimum	ASTM D-792	0.940
Tensile Strength at Yield Pounds per Inch Width	ASTM D-638 Mod. Per NSF Std. 54	120
Tensile Strength at Break Pounds per Inch Width	ASTM D-638 Mod. Per NSF Std. 54	180
Elongation at Break - %	ASTM D-638	500
Modulus of Elasticity – Pounds per Sq. In.	ASTM D-882	80,000
Tear Strength – Pounds	ASTM D-1004	30
Low Temperature Brittleness – Degrees F	ASTM D-746	-40
Dimensional Stability - % change Maximum each direction	ASTM D-1204 212 F. at 15 min.	+3
Environmental Stress Crack Resistance - hours	ASTM D-1693	500

3. STORAGE

Prior to use, the geomembrane shall be stored in a clean dry location, out of direct sunlight, not subject to extremes of either hot or cold temperatures, and with the manufacturer's protective cover undisturbed. The rolls shall be stored on a prepared surface (not wooden pallets) and should not be stacked more than two rolls high.

All geomembrane shall be free of damage or defect. Each package delivered to the job site shall bear the name of the material, the manufacturer's name or symbol, the quantity therein, and the thickness or weight of the material.

4. SUBGRADE PREPARATION

The surface on which the geomembrane is to be placed shall be graded to the neat lines and grades as shown on the drawings. The surface shall be reasonably smooth and free of loose rock and clods, holes, depressions, projections, muddy conditions, and standing or flowing water. All fill and excavated slopes shall be thoroughly compacted using a smooth wheel vibratory roller. The pond bottom shall be constructed on a minimum 2% slope for gas venting out of the bottom.

An anchor trench shall be excavated completely around the area to be lined at the planned elevation of the top of the lining. The trench shall be 16 inches deep and about 12 inches wide.

5. PLACEMENT

Prior to placement of the geomembrane, the soil surface will be reviewed for quality assurance of the design and construction. Each geomembrane panel shall be laid out and positioned to keep the number and length of the geomembrane field joints to a minimum and consistent with proper methods of geomembrane installation. Seams shall be oriented down, not across, the slope. Sharp corners shall be avoided. Horizontal and T-shaped seams on slopes must be kept to a minimum.

The method used to unroll the geomembrane panels shall not cause scratches or crimps in the geomembrane and shall not damage the supporting soil or underlying geotextile. The geomembrane shall be loosely spread over the geotextile. The geomembrane requires approximately 1-2 percent slack for satisfactory results.

The method used to place the panels shall minimize wrinkles (especially differential wrinkles between adjacent panels). Adequate loading (e.g., sandbags or similar items that will not damage the geomembrane) shall be placed to prevent uplift by wind. In case of high winds, continuous loading is recommended along the edges of the panels to minimize risk of wind flow under panels.

The top edge of the geomembrane liner and geotextile shall be placed in the anchor trench and anchored with compacted backfill. Compact backfill by wheel rolling with light rubber-tired equipment or manually directed power tamper.

Field seams shall be made by overlapping adjacent sheets and fusion welding the overlapped sheets using double fusion welders and extrusion welders. Seams between geomembrane sheets shall be field welded using the fabricator's seaming apparatus and technique.

The primary seaming method will be a double fusion welder. Prior to fusion seaming, all areas, which are to become seam interfaces, will be cleansed of dust and dirt. Seam joining shall not take place unless the sheet is dry and shall not be attempted when the ambient temperature is below 45 degrees F or above 90 degrees F.

The extrusion welders shall be used only in areas, which cannot be welded using double fusion welder. For extrusion welds, the geomembrane shall be preheated and pressed together to align for welding.

No base T-seams shall be closer than 5 feet to the toe of the slope. Seams shall be aligned with the least possible number of wrinkles and “fishmouths”. If a “fishmouth” or wrinkle is found, it shall be relieved and cap-stripped. All loose seam edges shall be removed on the exposed side, after seam strength testing has been completed, using a hook knife.

No equipment or tools shall damage the geomembrane by handling, trafficking, or other means. Personnel working on the geomembrane shall not smoke, wear damaging shoes, or engage in other activities that could damage the geomembrane. Use of metal tools shall be kept to a minimum.

6. REPAIR PROCEDURES

Defective seams shall be re-started / re-seamed as described in these specifications:

Small holes shall be repaired by extrusion cap welding. If the hole is larger than ¼ inch, it shall be patched.

Tears shall be repaired by patching. Tears with sharp ends and located on slopes or in areas of stress shall be rounded prior to patching.

Blisters, large holes, undispersed raw materials, and contamination by foreign matter shall be repaired by patching.

Surfaces of the geomembrane, which are to be patched, shall be abraded and cleaned no more than 15 minutes prior to the repair. No more than 10% of the thickness shall be removed. Patches shall be round or oval in shape and extend a minimum of 6 inches beyond the edge of defects. All patches shall be of the same compound and thickness as the geomembrane specified. All patches shall have the top edges beveled with an angle grinder prior to placement on the geomembrane. Patches shall be applied using approved methods only.

Re-start / Re-seaming Procedures – The welding process shall be re-started by grinding the existing seam and re-welding a new seam. Welding shall commence where the grinding started and must overlap the previous seam by at least 2 inches. Re-seaming over an existing seam without re-grinding shall not be permitted.

Verification of Repairs – Each repair shall be non-destructively tested. Repairs that pass the non-destructive test shall be taken as an indication of an adequate repair. Failed tests indicate that the repair shall be repeated and re-tested until passing test results are achieved.

7. SITE DRAINAGE

If shown on the site design, a drainage system shall be installed. The drain line will be installed at the lowest elevation of the pond. An extra layer of geotextile shall be placed over the aggregate to provide added protection. The drain shall outlet into a sump or filter area. Direct discharge into a stream shall be avoided.

8. VENTS

If shown on the site design, provide relief vents around the perimeter of the structure to allow gases to escape from under the geomembrane. Locate vents on a maximum spacing of 30 feet. Construct vents as recommended by the geomembrane manufacturer.

9. SEALING AROUND THE PENEFRATIONS

The seals around any penetration (pipe openings) shall be performed using a method as recommended by the geomembrane manufacturer.

10. FIELD QUALITY CONTROL

The installer shall non-destructively test all field seams over their full lengths. All test equipment shall be furnished by the installer:

- a. Air Pressure Testing (for double fusion seam only) – The following procedures are applicable to those processes that produce a double seam with an enclosed space. Equipment for testing double fusion seams shall be comprised of the following:
 - (1) An air pump equipped with pressure gauge capable of generating and sustaining a pressure between 25 and 30 psi and mounted on a cushion to protect the geomembrane.
 - (2) A manometer equipped with a sharp hollow needle, or other approved pressure feed device.

The following procedure shall be followed by the installer:

- (1) Seal both ends of the seam to be tested.

- (2) Insert needle of other approved pressure feed device into the tunnel created by the double fusion weld.
 - (3) Energize the air pump to a pressure between 25 and 30 psi, close valve, and sustain pressure for approximately 5 minutes.
 - (4) If loss of pressure exceeds 4 psi, or pressure does not stabilize, locate faulty area, repair and re-test.
 - (5) Remove needle or other approved pressure feed device and seal.
- b. Vacuum Box Testing (for extrudate seams – repairs) –
Equipment for testing extrusion seams shall be comprised of the following:
- (1) A vacuum box assembly consisting of a rigid housing, a transparent viewing window, a soft rubber gasket attached to the box bottom, a valve assembly and a vacuum gauge.
 - (2) A steel vacuum tank and pump assembly equipped with pressure controller and pipe connections.
 - (3) A rubber pressure/vacuum hose with fittings and connections.
 - (4) A plastic bucket and wide paint brush.
 - (5) A soapy solution.

The installer shall follow the following procedures:

- (1) Excess sheet overlap shall be trimmed away.
- (2) Clean the window, gasket surfaces and check for leaks.
- (3) Energize the vacuum pump and reduce the tank pressure to approximately 5 psi.
- (4) Wet a strip of the geomembrane approximately 12 inches by 48 inches (length of the box) with the soapy solution.
- (5) Place the box cover over the wetted area and compress.
- (6) Close the bleed valve and open the vacuum valve.
- (7) Ensure that a leak tight seal is created.

- (8) For a period of approximately 15 seconds, examine the geomembrane through the viewing window for the presence of soap bubbles.
- (9) If no bubbles appear after 15 seconds, close the vacuum valve and open the bleed valve, move the box over to the adjoining area with a minimum 3 inches overlap and repeat the process.
- (10) All areas where soap bubbles appear shall be marked, repaired, and then retested.

Defects and Repairs – All seams and non-seam areas of the geomembrane shall be inspected by the installer for defects, holes, blisters, undispersed raw material, and any sign of contamination by foreign matter. Because light reflected by the geomembrane helps to detect defects, the surface of the geomembrane shall be clean at the time of the inspection. The geomembrane surface shall be brushed, blown, or washed by the installer if the amount of dust or mud inhibits inspection.

All defects found during testing shall be repaired and re-tested. Such tests and adjustments shall be repeated until the repairs are complete.

11. FINAL TESTS AND INSPECTION

Upon completion of the work, the installation shall be subjected to a final inspection. All work in the system therein being tested shall be complete, cleaned, and ready for use. All work shall meet the requirements as to line, grade, cleanliness, and workmanship. All discrepancies shall be repaired.

12. BASIS OF ACCEPTANCE

The acceptability of the geomembrane liner shall be determined by inspection to check compliance with all the provisions of this specification. A written guarantee shall be furnished that protects the owner against defective workmanship and materials for not less than one year and that identifies the manufacturer and markings of the geomembrane.

13. MEASUREMENT AND PAYMENT

For items of work for which specific unit prices are established in the contract, the quantity of geomembrane placed within the specified limits will be determined to the nearest specified unit by measurements of the covered surface only, disregarding that required for anchorage, seams, and overlaps. Payment will be made at the contract unit price. Such payment will constitute full compensation for the completion of the work.