

CONSTRUCTION SPECIFICATION

PA 521A - POND SEALING OR LINING – FLEXIBLE MEMBRANE

1. SCOPE

The work shall consist of placing a synthetic flexible membrane in a pond to the elevations, grades, and cross sections as shown on the drawings or as staked in the field.

2. MATERIALS

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.

The manufacturer shall meet the National Sanitation Foundation Standard 54 requirements for Flexible Membrane Liners, and shall have at least five (5) years continuous experience in the manufacture of polyethylene geomembrane and/or experience totaling 10,000,000 square feet of manufactured polyethylene geomembrane.

The ~~HDPE~~ geomembrane or geosynthetic clay liner material shall meet the requirements specified in Section 15.

HDPE geomembrane shall meet the requirements of Table 1. Non-woven geotextile shall meet the requirements of Table 2. Other geomembranes, geosynthetics, and geotextiles shall be as specified in Section 15.

All seaming and welding materials, and all boots, coupling bands, channels and other appurtenances, shall meet the manufacturer's recommendations. For materials outside the scope of the manufacturer's recommendations, the engineer's approval must be obtained.

3. SUBGRADE PREPARATION

The area to be lined shall be drained and allowed to dry until the surface is firm and can support the men and equipment that must travel

over it during installation of the liner. All cut slopes and fills in the area to be lined must be sloped no steeper than 2.5 horizontal to 1 vertical. All fills and excavated slopes shall be thoroughly compacted using a sheepsfoot or smooth wheel vibratory roller. The pond bottom shall be constructed on a minimum two percent slope for gas venting out of the bottom.

The foundation area for liner shall be smooth and free of projections that can damage the geomembrane. Stumps and roots shall be removed. Rocks, hard clods, and other such material shall be removed, rolled with a smooth wheel vibratory roller so as to provide a smooth surface, or covered with a compacted cushion of fine soil.

When specified, an effective sterilant shall be applied to the subgrade at the rate recommended by the manufacturer.

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 18 inches deep and at least 15 inches wide.

4. PLACEMENT

All liner material shall be free of damage or defect and shall be stored so as to be protected from puncture, dirt, grease, water, moisture, mud, mechanical abrasions, excessive heat, or other damage. The rolls shall be stored on a prepared surface (not wooden pallets) and should not be stacked more than two rolls high.

The installation of the liner shall be directed at all times by an installer certified by the manufacturer. The installer shall provide proof of certification upon request by the engineer.

The liner shall be loosely spread over the prepared subgrade. Minimum laps of four inches shall be provided for all joints. The leading edge of the liner shall be placed in the

anchor trench so that the material extends across the trench bottom. Tack or weight sheets to hold them in place until the liner is installed.

If the liner becomes contaminated with soil material (mud), it shall be removed and replaced. Constant dampness of fine grained subbase may require use of four inches of clean sand.

Each liner panel shall be laid out and positioned to keep the number and length of the field joint seams to a minimum and consistent with proper methods of liner 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.

When a cushion geotextile or soil is required in Section 15, the liner shall be loosely spread over the cushion. Geomembranes requires approximately 1-2 percent slack for satisfactory results. Leave the geomembrane loose overnight to cycle through expansion and contraction to release tension on the membrane.

The method used to place the panels shall minimize wrinkles (especially differential wrinkles between adjacent panels). Ballast shall be used to prevent relocation of the compensating wrinkles by wind.

Adequate loading (e.g., sand bags or similar items that will not damage) liner shall be placed to prevent uplift by wind. In case of high winds, continuous loading is recommended along edges of panels to minimize risk of wind flow under the panels.

Direct contact with the shall be minimized, i.e., the liner in traffic areas shall be protected by an overlayment of geotextile, extra geomembrane, geosynthetic, or other suitable materials.

The top edge of the liner, and geotextile cushion if required, 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 field welded using the fabricator's seaming apparatus and technique. Prior to 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 32 degrees F or above 104 degrees F.

For geomembranes, extrusion welders shall be used only at areas which cannot be welded using the double fusion welder. For extrusion welds the geomembrane shall be preheated and pressed together to align for welding. No base T-seam shall be closer than five 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 extrusion welds shall have their top edges and bottom contact surfaces beveled with an angle grinder prior to placement on the geomembrane to remove oxidation.

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

5. REPAIR PROCEDURES

Defective seams shall be restarted/reseamed 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 patches.

Surfaces of geomembrane which are to be patched shall be abraded and cleaned no more than 15 minutes prior to the repair. No more than ten percent of the thickness shall be removed. Patches shall be round or oval in shape, made of the same geomembrane, and extend a minimum of six inches beyond the edge of defects. All patches shall have their top edges beveled with an angle grinder after

placement on the geomembrane. Patches shall be applied using approved methods only.

Restart/Reseaming Procedures – The welding process shall be restarted by grinding the existing seam and rewelding a new seam. Welding shall commence where the grinding started and must overlap the previous seam by at least two inches. Reseaming over an existing seam without regrinding shall not be permitted.

Verification of Repairs – Each repair shall be thoroughly checked for continuous, completed, solid welds with a uniform bead.

6. LEAK DETECTION AND FOUNDATION DRAINAGE

All sites shall have leak detection systems as shown in the design. The collection line will be installed at the lowest elevation of the pond. Unless otherwise required in Section 15, an extra layer of geotextile shall be placed over the aggregate to provide added protection. A four-inch corrugated polyethylene drain tubing, complying with the requirements of ASTM designation F405, shall be embedded in size 57 stone, ASTM designation C-33. Solid PVC SDR 26 pipe, ASTM designation D2241 or Schedule 40, ASTM D1785 shall be installed through the embankment. The outlet shall consist of at least ten feet of Schedule 40 pipe with an animal guard.

The leak detection system shall have a pipe outlet that discharges into an accessible sump or at the ground surface at least 50 feet from a stream or other water body. The leak detection system shall be separate and isolated from any groundwater drainage system that is installed around or under the facility.

7. VENTS

Provide relief vents within the top one foot around the perimeter of the structure to allow gases to escape from under the liner. Locate vents on a maximum spacing of 30 feet. Construct vents as recommended by the liner manufacturer, or as otherwise specified in Section 15.

8. SEALING AROUND THE PENETRATIONS

The seals around any penetration (pipe openings) shall be performed using a method recommended by the liner manufacturer, or as otherwise specified in Section 15.

9. FIELD QUALITY CONTROL

The Installer shall non-destructively random test field seams as directed by the liner manufacturer, or as otherwise specified in Section 15. All test equipment shall be furnished by the Installer:

a. FIELD TENSIONMETER TESTING (FOR DOUBLE FUSION SEAM ONLY)

- (1) Conduct this test prior to startup and once every three hours throughout the day for each seaming apparatus.
- (2) Cut samples from the ends of field welds.
- (3) Use a tensionmeter to test for shear and peel.
- (4) Specimens to be one inch wide with a grip separation of four inches plus the width of the seam.
- (5) The seam shall be centered between the clamps.
- (6) The rate of separation shall be two inches per minute.
- (7) Test results for seam strength properties shall be the average of five specimens.
- (8) Four out of five specimens shall pass seam acceptance criteria.
- (9) Shear and peel tests shall result in Film Tearing Bond (FTB), which is a failure in ductile mode of one of the bonded sheets by tearing prior to complete separation in the bonded area.
- (10) If a test seam fails to meet field seam specifications, the seaming apparatus and/or seamer shall not be used for

seaming until the deficiencies are corrected and a successful test seam is achieved.

- (11) If more than one of the five test specimens fails, another set of five specimens shall be tested. Failure of more than one, the second set of specimens will be cause for rejection of the seams represented by the failed specimens.

b. AIR PRESSURE TESTING (for DOUBLE FUSION SEAM ONLY)

The following procedures are applicable to those processes which 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 procedures shall be followed by the Installer:

- (1) Seal both ends of the seam to be tested.
- (2) Insert needle or 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 five minutes.
- (4) If loss of pressure exceeds 4 psi, or pressure does not stabilize, locate faulty area, repair and retest.
- (5) Remove needle or other approved pressure feed device and seal.

c. VISUAL METHOD

- (1) Thoroughly check for continuous, complete, and solid welds consisting of a steady bead.
- (2) Defects and Repairs – All seams and non-seam areas of the geomembrane shall be inspected by the Installer for defects, holes, blisters, undispersed raw materials, 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 inspection. The geomembrane surface shall be brushed, blown, or washed by the Installer if the amount of dust or mud inhibits inspection.
- (3) All defects found during testing shall be repaired and retested. Such tests and adjustments shall be repeated until the repairs are complete.

10. 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.

11. PROTECTION AND SAFETY

All facilities with exposed flexible membranes shall be equipped with a means of emergency egress at two or more locations. For those facilities with intended access points, emergency egress shall be provided at each access point. The means of egress shall be as shown in the drawings or in Section 15, and shall be approved by the engineer.

All facilities with exposed flexible membranes shall be fenced to protect the liners from livestock and wildlife. Fencing shall be installed in accordance with the applicable specification. Posts shall be set outside the anchor trench. Fence shall be five feet high. Safety signs shall be installed on each side of the storage.

Areas of concentrated surface flow into the pond shall be protected against erosion by means of installing an extra layer of liner, or as otherwise required in Section 15.

12. BASIS OF ACCEPTANCE

The acceptability of the liner shall be determined by inspections to check compliance with all the provisions of this specification with respect to the drawings, markings, the appurtenances, and the minimum installation requirements.

The installing contractor shall certify that the installation complies with the requirements 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 liner.

13. VEGETATIVE COVER

Unless otherwise specified, a protective cover of vegetation shall be established on the disturbed

area outside of the liner. The planting of vegetation shall conform to the requirements of Construction Specification PA342, Critical Area Planting.

14. CONSTRUCTION OPERATIONS

Construction operations shall be performed in such a manner that erosion and air and water pollution are minimized and held within legal limits. The owner, operator, Contractor or other persons will conduct all work and operations in accordance with proper safety codes for the type of construction being performed with due regards to the safety of all persons and property. The installation shall be completed in a workmanlike manner and present a neat and pleasing appearance.

15. ADDITIONAL CONDITIONS WHICH APPLY TO THIS PROJECT ARE:

TABLE 1 - Properties of Smooth HDPE Geomembranes

<u>TEST DESCRIPTION</u>	<u>TEST METHOD</u>	<u>MINIMUM AVERAGE ROLL VALUES</u>	
		<u>40 mil.</u>	<u>60 mil.</u>
Thickness - mils minimum	ASTM D-1593	36	54
Specific Gravity – minimum	ASTM D-792	0.940	0.940
Tensile Strength @Break Pounds/in. Width	ASTM D-638 (Type IV at 2 IPM)	152	228
Tensile Strength @Yield	ASTM D-638		

PA521AP-SP6

Pounds/In. Width	(Type IV at 2 IPM)	84	126
Elongation @Break, % (2.5" G.L.)	ASTM D-638 (Type IV at 2 IPM)	560	560
Elongation @Yield, %	ASTM D-638 (Type IV at 2 IPM)	12	12
Tear Strength, lbs.	ASTM D-1004	28	42
Puncture Resistance, lbs.	ASTM D-4833	72	108
Carbon Black Content, %	ASTM D-1603	2-3	2-3
Carbon Black Dispersion	ASTM D-5596	8 in Cat. 1 &2; 10 in Cat. 1, 2, &3	
Seam, Shear, ppi	ASTM D-4437	80	120
Seam, Peel, ppi	ASTM D-4437	52 & FTB	78 & FTB

TABLE 2 - Properties of Non-Woven Geotextiles

<u>TEST DESCRIPTION</u>	<u>TEST METHOD</u>	<u>MINIMUM AVERAGE ROLL VALUES</u>
Weight - oz/square yard	ASTM D-3776	12
Thickness, mils	ASTM D-1777	130
Grab Strength, lbs.	ASTM D-4632	275
Grab Elongation, % maximum	ASTM D-4632	50
Trap, Tear Strength, lbs.	ASTM D-4533	115
Puncture Strength - lbs.	ASTM D-4833	185
Mullen Burst Strength, psi	ASTM D-3786	650
Permeability, cm/sec	ASTM D-4491	0.2
Permittivity, sec ⁻¹ gal/min/ft ²	ASTM D-4491	0.9 60
AOS, U. S. Standard Sieve	ASTM D-4751	100