

**NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE CONSTRUCTION SPECIFICATION
POND SEALING OR LINING - FLEXIBLE MEMBRANE
CODE 521A**

1. SCOPE

The work shall consist of furnishing, installing and testing high-density polyethylene (HDPE) or ethylene propylene diene terpolymer (EPDM) linings and the necessary mechanical attachments as specified and as shown on the construction drawings. When the installed liner will too contain animal waste, the New Mexico Environment Department (NMED) shall be notified prior to beginning the work.

2. SITE PREPARATION

Site preparation (mobilization and demobilization, clearing and grubbing, structure removal, pollution control, and water for construction) shall be in accordance with Construction Specification 587.

3. MATERIALS

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

The manufacturer shall provide written certification of all of the following items:

- The material is suitable for the intended use;
- The expected service life of the flexible membrane under the anticipated conditions;
- The physical properties of the liner.

HDPE liners shall have a minimum nominal thickness of 40 mils. The liner shall be manufactured to be suitable for use in either exposed or buried conditions. Smooth HDPE shall be used unless otherwise specified or as may be shown on the drawings. The HDPE liner shall be manufactured from virgin polymer material and shall meet the following property values:

Property	Test methods	HDPE Requirements*	
		Smooth	Textured
Density, g/cc	ASTM D 1505	0.940	0.940
Tensile Properties	ASTM D 638 (type IV at 2 in/min)		
yield stress, lb/in		84	84
break stress, lb/in		60	152
yield elongation, %		12	12
break elongation, %		100	700
Tear resistance, lb	ASTM D 1004	28	28
Puncture resistance, lb	ASTM D 4833	60	72
Carbon black content, %	ASTM D 1603	2 - 3	2 - 3
Carbon black dispersion	ASTM D 5596	Cat 1-2	Cat 1-2
Seam properties	ASTM D 4437 (1 in wide at 2 in/min)		
shear strength, lb/in		80	80
peel strength, lb/in**		52/FTB	52/FTB

* All values, unless specified otherwise, are minimum average roll values as reported by the specified test methods.

** Film tear bond (FTB): A failure of one of the bonded sheets by tearing prior to complete separation in the bonded area.

EPDM liners shall have a minimum nominal thickness of 45 mils and shall be formulated from virgin compounding materials. Re grind, reworked or trim materials shall be from the same manufacturer and the same formulation as the liner. Recycled materials shall not be allowed. Nonreinforced EPDM shall be used unless otherwise specified or as may be shown on the drawings.

Property	Test methods	EPDM Requirements*	
		Nonreinforced	Reinforced
Specific gravity	ASTM D 792	1.1	1.1
Tensile properties	ASTM D 882 (Type IV at 20 in/min)		
break strength, lb/in		50	n/a
break elongation, %		400	n/a
Tensile properties	ASTM D 751, Method A	n/a	125
Tear resistance, lb	ASTM D 1004	9	n/a
Tear resistance, lb	ASTM D 5884, Method B	n/a	130
Puncture resistance, lb	ASTM D 4883	35	n/a
Puncture resistance, lb	FTMS**** 101C, Method 2031	n/a	45
Ply adhesion, lb/in	ASTM D 413, Machine Method	n/a	7
Low temperature brittleness, °F	ASTM D 1790	<-45	<-45
Seam properties	ASTM D 413/D 4437 (NSF modified 20 in/min strain rate)		
shear strength, lb/in**		35	n/a
peel strength, lb/in***		14	n/a
Seam properties			
shear strength, lb/in**	ASTM D 751	n/a	35
peel strength, lb/in***	ASTM D 413	n/a	14

* All values, unless specified otherwise, are minimum average roll values as reported by the specified test methods.

** At 200 percent strain.

*** Cohesive bond mode.

**** Federal Test Method Standard

Gasket material shall be neoprene, closed cell medium, 0.25 inch thick, with adhesive on one side, or other gasket material as approved by the liner manufacturer. Metal battens shall be 0.25 inch thick by 2 inches wide stainless steel. Clamps shall be 0.5-inch-wide stainless steel. The HDPE embed channel and welding rod shall have the same properties as the liner. Adhesives shall be approved by the manufacturer and shall consist of material with a life expectancy similar to the liner material. Sealant shall be as recommended by the manufacturer.

Shop drawings shall be furnished to the designer for approval before proceeding with field work. The liner material must be pre-approved by a licensed professional engineer and the New Mexico Environment Department prior to its installation. Items to consider in the shop drawings include, but are not limited to:

- Extent, size and details of the lining.
- Termination and methods of sealing around penetrations.
- Manufacturer's written instructions for the storage, handling, installation, inspections and field splices, seams and joints.

The liner will be factory fabricated into panels as large as is practical for placement. Factory made seams shall be least 80% of the specified sheet strength.

After fabrication, the lining will be packaged for minimum handling in the field. Shipping boxes will be substantial enough to prevent damage to contents.

4. SHIPPING AND STORAGE

Liner material shall be delivered, handled, and stored according to the manufacturer's recommendations. Liner material shall be stored and protected from puncture, dirt, grease, excessive heat, exposure to ultraviolet radiation, or other damage.

5. EARTHWORK

Earthwork (common excavation and earthfill) shall be in accordance with Construction Specification 587.

6. SUBGRADE PREPARATION

Foundation work (diverting surface water, dewatering the construction site, dewatering borrow areas, and foundation preparation) shall be in accordance with Construction Specification 587 and excavated to a depth at least 6 inches below the liner.

The area to be lined shall be compacted to provide a dry, firm unyielding foundation. All banks and fills within the area to be lined must be shaped to the slopes and elevations as shown in the construction drawings.

The supporting surface slopes and foundation to accept the liner shall be stable and free from deviations of more than 3 inches (75 mm). If the liner will too contain animal waste, Subgrade compaction must comply with the NMED requirements, currently set at 90% Standard Proctor Density.

The foundation area for flexible membrane linings shall be very smooth and free of foreign and organic material, rocks larger than $\frac{3}{8}$ inch, any angular rocks, sharp objects, or any other projections that might damage the lining. Coverage by equipment tracks or roller shall provide a smooth surface prior to liner installation. Surface deformations shall not exceed 1 inch.

If the design requires a soil sterilant, it shall be applied to the subgrade at the rate recommended by the manufacturer.

7. LINER PLACEMENT

Installation shall be carried out in a safe manner in such a way that erosion and air and water pollution are minimized.

The liner shall be installed in accordance with the manufacturer's recommendations and by a qualified installer. When the liner will too contain animal waste, the installer shall be approved and certified by the NMED, and NMED shall be notified upon completion of the liner installation. The following shall apply unless the certified installer directs otherwise:

- The subgrade must be inspected and approved by the Engineer and the Installer prior to the placement of the liner.
- The liner shall not be placed during fog, precipitation, in the presence of excessive winds, or in temperatures less than 50 °F.
- The anchor trench in the top berm shall be excavated to the lines, grade, and dimensions shown on the drawings. The trench corners shall be slightly rounded to prevent sharp bends in the liner. The trench shall be a minimum of 12 inches wide, 12 inches deep and shall be set back at least 24 inches from the inside edge of the berm. The top of the lining shall be placed in the anchor trench as per manufacturer's requirements and anchored with compacted backfill. Standing water, mud, and snow shall be removed prior to liner placement and trench backfill.
- The liner shall be installed with a minimum of handling by using a spreader bar assembly attached to a front-end loader, track-hoe bucket, or any other methods recommended by the liner manufacturer.
- The liner shall be carefully spread over the subgrade so that it lies in a relaxed state, conforming to the surface without stretching. Wrinkles shall not exceed 6 inches in height or "fold-over" as the pond fills or backfill is placed in the anchor trenches. Any wrinkles shall be smoothed out.
- The liner shall be placed parallel to the direction of maximum slope. Horizontal laps will not be allowed on slopes. Upslope panels shall overlap downslope to provide a shingle effect for

drainage. The contact surfaces of the panels will be wiped clean to remove all dirt, dust, moisture or other foreign materials. All field splices, seams and joints will be inspected and approved prior to placement of any soil cover material.

- During installation, the liner shall be secured with sandbags to protect from wind uplift forces.
- The liner shall be seamed and secured by the end of each workday.
- Construction equipment shall not be allowed to operate directly on the liner except for all-terrain vehicles that produce ground pressures less than 5 pounds per square inch.
- Vents shall be as detailed on the construction drawings.
- Any opening in the liner through which a pipe or other fixture protrudes shall be sealed in accordance with the manufacturer's recommendation.
- Any damage to the liner shall be patched with the lining material itself in accordance with the manufacturer's recommended procedures. Patches shall overlap the main panel by at least 6 inches (150 mm) on all sides.
- If required in the design, placement of cover soil shall commence immediately following approval of the liner placement. The soil material to be used for protective cover shall be free of large clods, sharp rocks, sticks and other objects that would puncture the lining. Equipment may be used to spread the protective soil cover but shall not be allowed to directly contact the liner. The cover soil material shall be placed to the depth as shown on the construction drawings without damage to the liner.

8. SEAMING METHODS AND PROCEDURES

Seaming shall extend to the outside edge of the liner to be placed in the anchor trenches. Seaming shall not be conducted in the presence of excessive winds, moisture, dust, dirt, standing water, or soft subgrade. Seaming procedures shall be in accordance with the liner manufacturer's recommendations.

HDPE Liner

The primary method of seaming for HDPE liners shall be hot wedge welding accomplished by a double-wedge fusion welder that produces a double track weld. Welding equipment and accessories shall be in accordance with the liner's recommendations. The welder shall be calibrated at least once per day at the beginning of each seaming period.

Fillet extrusion welding shall be used for repairs, T-seams, and detail work. Before fusion welding or extrusion welding, all areas to become seam interfaces shall be cleaned of dust and dirt. Seam joining shall not take place unless the sheet is dry and shall not be attempted when the ambient sheet temperature is below 45 °F or above 90 °F. All field splices, seams and joints shall be made in accordance with the manufacturer's recommended technique, using materials furnished for that purpose. Liner panels shall have a minimum overlap of 4 inches for hot shoe welding and 3 inches for extrusion welding.

EPDM Liner

Seams shall be joined using double-faced inseam tape or a cover strip recommended by the manufacturer. Seaming shall not be performed when the ambient sheet temperature is below 45 °F or above 100 °F.

When installing the inseam tape, a primer shall be applied to both panels by a scrub pad or other approved method recommended by the manufacturer. The primer shall cover the entire seam overlap. As soon as the primer has "flashed," install the tape on the bottom sheet, remove tape backing, lap the top sheet over the tape, and roll with a sufficient pressure to provide adequate contact between the panels.

When installing the cover strip, a primer shall be applied to both panels by a scrub pad or other approved method recommended by the manufacturer. The top sheet shall be lapped over the bottom

sheet and rolled to provide contact between the panels. Additional primer shall be applied to cover the entire seam overlap. As soon as the primer has "flashed," install the cover strip and roll it with sufficient pressure to provide adequate contact between the cover strip and the panels.

9. FIELD TESTING

Field seams shall be nondestructively tested over their full length. Seam testing shall be performed as the work progresses.

HDPE Liner

Air pressure tests shall be performed in accordance with ASTM D 5820 on all double-track fusion seams. The air pressure test equipment and procedures shall conform to this specification and the liner manufacturer's specifications. Seal both ends of the seam to be tested. Insert the pressure needle into the seam's air channel. Pressurize the air channel through the needle to 25 to 30 pounds per square inch. Monitor the pressure for 5 minutes. A loss of pressure in excess of 4 pounds per square inch or a continuous loss of pressure is an indication of a leak. Terminate the test by relieving the pressure from the opposing end of the seam. The pressure shall immediately drop to zero upon opening the opposing end of the seam. If this does not occur, the seam channel shall be checked for obstructions and retested. All defects shall be marked for repair.

Vacuum box tests shall be performed in accordance with ASTM D 5641 on all extrusion welds. The vacuum box equipment and test procedure shall conform to this specification and the liner manufacturer's specifications. Apply soapy water solution to the seam area to be tested. The vacuum box, equipped with a transparent viewing window, shall be centered over the seam area and a vacuum of 3 pounds per square inch shall be drawn. The seam area shall be visually monitored for any soap bubbles for 15 seconds. Seam testing shall continue by overlapping a minimum of 3 inches between each test interval. All defects shall be marked for repair.

If required, seam samples shall be cut at no more than one sample per 500 feet of weld for destructive seam testing. All destructive seam samples shall be tested by a tensiometer in shear and peel modes in accordance with ASTM D 6392 to verify seams meet the requirements of this specification.

The frequency and type of testing shall be in accordance with the manufacturer's recommendations and at other times, at the request of the inspector. All splices, seams, joints and repairs shall be checked during and after installation by use of the testing methods recommended by the manufacturer.

EPDM Liner

Air lance test shall be performed in accordance with ASTM D 4437. The location of all defective seams shall be marked and repaired.

If required, seam samples shall be cut at no more than one sample per 500 feet of seam for destructive seam testing. All destructive seam samples shall be tested by a tensiometer in shear and peel modes in accordance with ASTM D 6392 to verify seams meet the requirements of this specification.

10. REPAIRS

All defective liner areas and failed seams shall be repaired and retested.

All tears, punctures, and material defects in the liner shall be repaired by installing a patch over the defective area. Surfaces of the liner to be patched shall be cleaned before the repair. All patches shall be of the same liner material and extend a minimum of 6 inches beyond the edges of the defect area. All patches shall have rounded corners and shall be seamed to the liner. Holes that are less than 0.25 inch in diameter in the HDPE liner shall be repaired by a bead of extrudent.

Failed seams shall be repaired by installing a cap strip over the entire length of failed seam. The cap strip shall be of the same liner material and shall extend beyond the failed seam a minimum of 6 inches in all directions.

11. MECHANICAL ATTACHMENTS

The liner shall be mechanically attached to pipe, concrete, or steel structures as shown in the drawings and according to the liner manufacturer's specification.

Pipe boots shall be fabricated in the field from the same liner as that shown in the drawings. HDPE boots shall be welded and clamped to polyethylene pipe. Pipe boots shall be clamped to other types of pipe as shown in the drawing, or as recommended by the manufacturer, to provide a leak-free attachment.

Metal battens shall meet the requirements of this specification and shall be installed according to the drawings and the liner manufacturer's specifications. The battens shall be bolted to structural concrete by epoxy coated bolts on 6-inch intervals to create a leak-free connection under submerged conditions. Bolt spacing shall be increased to 12 inches for connections above the fluid level.

HDPE embed channel, if used, shall meet this specification and be installed according to drawings and the liner manufacturer's specification. The embed channel shall be prefabricated to the dimensions as shown in the drawings. All sections of the channel shall be welded to the next section continuously to prevent gaps between sections or pieces of the embed channel before their installation in the concrete forms. All corners shall be miter cut and welded all around.

12. CONCRETE

Concrete shall be in accordance with Construction Specification 587C.

13. CERTIFICATION

Upon completion of liner installation, the installer and contractor shall provide documentation to the Owner and NMED (if the liner will too contain animal waste) certifying the liner meets or exceeds the material specifications and that it was installed in accordance with the manufacturer's recommendations. In addition, the results of the testing program shall be furnished to the Owner and NMED (if appropriate). As-built drawings shall be submitted to the Owner and NMED (if appropriate) within 30 days of completion of construction. The expected service life of the liner is 20 years.

Conservation Practice Job Sheet 521A shall be completed by the certifying NRCS representative and filed in the Conservation Plan folder in front of the completed practice documentation.

14. MEASUREMENT

The quantity of liner shall be determined to the nearest square yard by measuring the installed liner with a calibrated measuring wheel. The total quantity shall include the liner installed in the anchor trench, in areas with double liner, and rub sheets according to the drawings, but shall exclude scrap, waste, overlap, and compensations for expansion and contraction of liner.

Project Name:
Date:

ITEMS OF WORK AND CONSTRUCTION DETAILS:

Items of work to be prepared in conformance with this specification and the construction details are: