



PIG® Well Pad Liner Specifications

1. Geomembrane Raw Materials

1.1 Resin

The geomembrane shall be manufactured of polypropylene resins produced in the United States and shall be compounded and manufactured specifically for the intended purpose. The resin manufacturer shall certify each lot for the following properties.

Melt Flow Rate: ASTM D 1238

1.2 Geotextile

The geotextile manufacturer shall certify each lot for the following properties. The tests are completed every 60,000 square feet.

Weight: ASTM D 5261

Thickness: ASTM D 5199

Grab Tensile: ASTM D 4632

Grab Elongation: ASTM D 4632

Trapezoidal Tear: ASTM D 4632

Permittivity: ASTM D 4491

Water Flow Rate: ASTM D 4491

Apparent Opening Size: ASTM D 4751

2. Geomembrane Production

2.1 Geotextile

Weight verification checked on each roll during manufacturing.

2.2 Geomembrane

All geotextile rolls are recorded for each geomembrane roll. Sheet surface appearance shall be monitored for flaws. Flaws include bubbles, wrinkles, and irregularities in lamination.

A. Sampling

Full width samples shall be taken as retains from the end of each roll to the manufacturer's laboratory.



B. Testing

The geomembrane quality control testing shall include:

Weight
Bond strength
Dimensions

C. Reporting

Results from the testing shall be reviewed by the quality control manager. The test data shall then be transferred to the product data file for roll certification. Material that does not meet specifications shall be identified and placed on hold.

2.3 Factory Seam

All geomembrane rolls are recorded for each factory seamed roll.

2.3.1 Appearance

Sheet surface appearance shall be monitored for flaws. Flaws include bubbles, wrinkles, irregularities in lamination, seam alignment, splice alignment, excessive overlap of seams, and exposed barrier film.

2.3.1 Testing

Three 1" wide samples are cut from the end of the each roll for every seam. Two of samples are tested for tensile strength. One sample is retained for a year. If the samples peel apart at the barrier film interface, this an adhesive failure and the roll is rejected. Failure mode must be cohesive failure of the geotextile layer. If the overall tensile strength is less than 70 lbs for the 130 mil liner, the roll is also rejected.

Both seams are vacuum tested at the end of every roll. Visible pinholes in exposed barrier film are not acceptable and do not met specification. The roll is rejected.

2.4 Roll Packaging

2.4.1 Identification

Three tags per roll shall be used.

1. One inside the core.
2. Two on outside roll covering. One on each end of the roll.

2.4.2 Protection

All rolls are wrapped in reinforced waterproof plastic.



2.5 Out-of-Spec. Material

Any roll not meeting the specification for any of the above inspections shall be separated from other rolls and placed on hold. Any nonconforming material is recycled back to resin.

3. Geomembrane Installation

3.1 Materials Logistics

Roll numbers are recorded on every invoice.

The geomembrane rolls shall be shipped by flatbed trailer to the job site. The geomembrane shall be stored so as to be protected from puncture, dirt, grease, moisture and excessive heat. Damaged material shall be stored separately for repair or replacement.

3.2 Site Preparation

Prior to liner installation, the subgrade shall be compacted in accordance with the project specifications. Weak or compressible areas which cannot be satisfactorily compacted should be removed and replaced with properly compacted fill. All surfaces to be lined shall be smooth and free of all stones greater than 2" diameter, sharp objects, or debris of any kind. The subgrade shall provide a firm, unyielding foundation with no sharp changes or abrupt breaks in grade.

Standing water, mud and snow and excessive moisture should be avoided. If unavoidable, then field seam testing frequency should be increased. Temperature and welding speed should be adjusted accordingly.

The installer, on a daily basis, shall approve the surface on which the geomembrane will be installed. After the supporting soil surface has been approved, it shall be the installer's responsibility to indicate to the inspector any changes to its condition that may require repair work.

3.3 Method of Placement

The rolls shall be deployed using a spreader bar assembly attached to a loader bucket or by other methods approved by the project engineer.

The installer shall be responsible for the following:

1. Equipment or tools shall not damage the geomembrane during handling, transportation and deployment.
2. Personnel working on the geomembrane shall not smoke or wear damaging shoes.
3. The method used to unroll the panels shall not cause wrinkles in the geomembrane.
4. Adequate loading (e.g., sand bags 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 edges of panels to minimize risk of wind flow under the panels).



3.4 Field Seaming

The approved seaming process is fusion welding. Seams shall be aligned with the least possible number of wrinkles.

3.4.1 Weather Conditions

Geomembrane deployment shall proceed between ambient temperatures of 32° F and 104° F. Installation can proceed below 32° F only after it has been verified by the inspector that the material can be seamed according to the specification.

Geomembrane deployment shall proceed in dry conditions. Installation can proceed in wet conditions after it has been verified by the inspector that the material can be seamed according to the specification. Testing frequency should increase in wet conditions. Temperature and welding speed should be adjusted accordingly.

3.4.2 Seam Overlap

Geomembrane panels must have a finished minimum overlap of 2.5 inches for fusion welding. The top layer must overlap the onto the geotextile surface by 0.25" to 0.5".

3.4.3 Test Seams

Field test seams shall be conducted on the liner to verify that seaming conditions are satisfactory. Test seams shall be conducted at the beginning of each seaming period and at least once every 4 hours, for each seaming apparatus and personnel used that day.

If the test seams meet specifications, fusion welding will proceed without changing that machine/operator combination or any settings. If trial seams fail, then that equipment will not be used until adjustments have been made and passing trial seams made.

All test seams shall be made in contact with the subgrade.

The seam shall be tested according to ASTM D 7747. Break code AD (adhesive failure) is not allowed. If trial seams fail, then that equipment will not be used until adjustments have been made and passing trial seams made.

Three specimens shall be cut from each end of the test seams by the inspector. The inspector shall use a tensiometer to test 3 specimens for shear and 3 specimens for peel. Each specimen shall be one inch wide with a grip separation of 4 inches plus the width of the seam. The seam shall be centered between the clamps. The rate of grip separation shall be 2 inches per minute.

3.4.4 Destructive Seam Testing

Destructive seam testing should be minimized to preserve the integrity of the liner. The installer shall provide the inspector with one destructive test sample per project specifications (usually once per 500 feet of seam length) from a location specified by the inspector. For well pads, the samples can be cut from the end of every field seam.

A. Sampling Procedure

In order to obtain test results prior to completion of liner installation, samples shall be cut by the installer as the seaming progresses. The installer shall also record the date, location, and pass or fail description. All holes in the geomembrane resulting from obtaining the seam samples shall be immediately patched.



B. Size and Disposition of Samples

The samples shall be 12 inches wide by 36 inches long with the seam centered lengthwise. The sample shall be cut into three equal-length pieces, one to be given to the inspector, one to be given to the owner and one to the installer.

C. Field Laboratory Testing

The inspector shall test ten 1-inch wide specimens from his sample, five specimens for shear strength and five for peel strength.

D. Independent Laboratory Testing

The owner, at his discretion and expense, may send seam samples to a laboratory for testing. The test method and procedures to be used by the independent laboratory shall be the same as used in field testing.

E. Procedures for Destructive Test Failure

The following procedures shall apply whenever a sample fails the field destructive test:

1. The installer shall cap strip the seam between the failed location and any passed test locations.
2. The installer can retrace the welding path to an intermediate location (usually 10 feet from the location of the failed test), and take a sample for an additional field test. If this test passes, then the seam shall be cap stripped between that location and the original failed location. If the test fails, then the process is repeated.
3. Over the length of seam failure, the installer shall either cut out the old seam, reposition the panel and reseam, or add a cap strip.

3.4.5 Non-Destructive Seam Testing

The installer may be required to non-destructively test all seams over their full length for seam integrity. There are three non-destructive tests that can be used with Pig® Well Pad Liner according to ASTM D4437: Air Lance Test, Mechanical Point Stressing, or Vacuum Box Testing. If the Vacuum Box Testing is used, the seams must be tested and reported according to ASTM D5641.

A. Air Lance Test

1. Inspect all seams for unbounded areas using an air nozzle directed on the upper seam edge and surface to detect loose edges, ripples indicating unbounded areas within the seam, or other undesirable seam conditions.
2. Check all bonded seams using a minimum 50 psi air supply directed through a 3/16 inch nozzle, held not more than 2 inches from the seam edge and directed at the seam edge.

B. Mechanical Point Stressing

1. A blunt instrument shall be run along the edge of the seam to find obvious unbounded areas. The procedure shall not puncture or otherwise damage the liner.



C. Vacuum Box Testing

1. Equipment

- a) A vacuum box assembly consisting of a rigid housing, a transparent viewing window, a soft rubber gasket attached to the bottom, a vacuum gauge and vacuum source. Unit needs to pull a vacuum level of 3 to 5 in Hg. New Pig recommends using a DemTech Self Contained Vacuum Plate.
- b) Soap solution consisting of approximately 1 teaspoon of liquid dish soap per gallon of water. Alternately, windshield washing fluid may be used.
- c) A garden pump sprayer for the application of the soap solution.

2. Procedure

- a) Wet along the seam of liner with the soap solution for at least the length of vacuum box. The felt surface will wick and spread the solution.
- b) Place the vacuum box over the wet seam and turn it on to create a vacuum of 3-5 in Hg.
- c) Examine the seam for soap bubbles created by pinholes. Bubbles due to pinholes will move from the center of the seam to the closest edge of the vacuum box and will not typically trace the seam.

NOTE: If active bubbles are tracing the length of the seam, it is due to the air leaking in between the seam's top surface and the vacuum box's gasket. Allow this bubbling to subside before checking for seam pinholes.

NOTE: Bubbling along the outside edge of the tester is caused by the felt texture and is not due to pinholes.

- d) For a period of 10 seconds, examine the liner seam through the viewing window for the presence of pinhole bubbles. If seam pinhole bubbles are detected, mark that seam section for repair.
- e) If no pinhole bubbles appear after 10 seconds, release the vacuum and continue checking the rest of the seam.
- f) Test all in-field seams, factory seams and liner patches for pinholes.
- g) Record all leaks by seam location.
- h) All areas where pinhole bubbles appear must be repaired and then retested. Refer to Section 10.
The Installer shall non-destructively test all field seams over their full length.



3.4.6 Defects and Repairs

All seams and non-seam areas of the geomembrane shall be inspected by the inspector for defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. The surface of the geomembrane shall be clean at the time of inspection.

B. Repair Procedures

1. Cap strip-- Defective seams shall be cap stripped. The cap strip must be at least 6" wider than the seam. Sealant must be placed underneath. Heat tacking the edges afterwards is suggested to protect the sealant. Apply sealant around patch edges, and then work into liner surface.
2. Patch--Holes and tears shall be repaired with sealant covered by patches. The patch should be at least 6 inches larger in each direction. Heat tacking the edges afterwards is suggested to protect the sealant. Apply sealant around patch edges, and then work into liner surface.

3.5 Geomembrane Acceptance

The installer shall retain all ownership and responsibility for the geomembrane until accepted by the owner.

Final acceptance is when all of the following conditions are met:

1. Installation is finished.
2. Verification of the adequacy of all field seams and repairs, including associated testing, is complete.