



Technical Specification Guidelines

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2.01 General

Furnish and completely install the Firestone EPDM Geomembrane System in accordance with Firestone's published specifications and details.

2.02 Submittals

A. Panel Layout

1. The installation contractor shall provide a panel layout drawing or plan.
2. This plan shall be made based on the specification and design details, and will indicate the position of the panel and field seams.
3. The placement of the panels will proceed according to this plan unless changes must be made due to unforeseen site conditions.

B. Installation Details

The installation contractor shall provide copies of any special detail terminations that may be required.

2.03 Job Site Considerations (Cautions and Warnings)

A. Ignition Sources

Keep all adhesives, sealants and cleaning materials (e.g. gas, heptane, etc.) away from ALL ignition sources (i.e. torches, flames, fire, sparks, etc.).

B. Safety Instructions

Consult container labels and Material Safety Data Sheets (MSDS) for specific safety instructions.

C. Storage

Store Firestone EPDM Geomembrane in the original undisturbed plastic wrap in such a manner as to protect it from becoming damaged.

D. Membrane Contamination

Do not use oil-based or bituminous-based materials with Firestone EPDM Geomembrane.

E. Miscellaneous Contamination

All bonding, splicing, and sealing surfaces must be free of dirt, moisture, and any other contaminants.

F. Temperature

When the outside temperature is below 4.4° C (40° F), certain combinations of temperature and humidity may cause condensation on the surface of solvent-based adhesives and primers. If this condition occurs, discontinue the application. When the ambient air conditions no longer cause condensation on the adhesive surfaces, re-apply additional adhesive or primer and proceed.

1. The consistency of sealants, adhesives and primers will begin to thicken as the temperature drops. To minimize this, the following is recommended:
 - a. Start work with sealants, adhesives and primers that have been stored between 15.5° C and 26.7° C (60° F and 80° F). Insulated and/or heated boxes may be helpful.



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- b. Complete test areas to determine if conditions will cause problems such as condensation with the application of the material.
 - c. Stop the operation or change to another warm container when material becomes too thick to properly dry.
2. Do not use heat guns or open flames to dry adhesives and primers.
- G. Cautions
- Do not thin or modify any Firestone material
- H. Deliver materials to job site in their original containers as labeled by the manufacturer.
- I. Follow manufacturer's directions for protection of materials prior to and during installation. Do not use materials, which have been damaged to the point that they will not perform as specified.
- J. Care should be taken not to damage the Firestone EPDM Geomembrane during transport, loading, and unloading. The rolls must be stacked on a flat, clean surface, free of sharp protrusions that could damage the geomembrane.
- K. Firestone EPDM Geomembrane does not require any special protection against weather conditions. However, all accessories need to be stored in a dry and cool place between 10° C and 25° C (50° F and 77° F), protected against extreme weather conditions.

2.04 Substrate Preparation

- A. Inspection of Support Surface
- 1. As part of Construction Quality Control (CQC) and before installing the Firestone EPDM Geomembrane, quality of the soil subgrade and the surface condition should be examined to determine the preparation steps required for installing the Firestone EPDM Geomembrane lining system.
- B. Soil Preparation
- 1. The support soil layer in immediate contact with the Firestone EPDM Geomembrane shall be a clean, compacted, and regular surface free of aggressive angle changes, ruts, loose stones, stones in excess of 9.52 mm (0.375"), and small cavities. This layer should also be able to compensate for the differential settling of the soil and facilitate the installation of a drainage system, if required. Adequate support may be realized in the following ways:
 - a. Excavate the unsuitable subgrade base, remove rock, vegetation, etc., followed by smoothing and compacting of the base.
 - b. Backfill with layers of controlled particle size which are compacted (sand, select fill material) to the desired grade.
- C. Vegetation
- All plant growth should be removed from the base soil prior to compaction in order to avoid any gas generation and compressible areas. Depending on the conditions, the use of water-based herbicide is recommended. The herbicide must not contain any chemicals, known to affect the Firestone EPDM Geomembrane lining system.



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D. Compaction

1. All soils supporting the Firestone EPDM Geomembrane System must be compacted to between 90% and 95% of standard Proctor density. The density is achieved by either equipment travel or by mechanical methods. When mechanical methods are used, the soil material is deposited in layers of 152.4 mm to 304.8 mm (6" to 12") and compacted with a vibrating roller or other similar methods.
2. The supporting surface should not contain any loose stones with a diameter exceeding 9.52 mm (0.375"). The final surface should be smooth and uniform with no abrupt changes in elevation.
3. An additional layer of sand should be provided and/or a geotextile underlayment of at least 271.25 g/m² (8.0 oz/yd²) should be installed. On embankments and on any type of rough substrate (concrete, masonry) a geotextile underlayment of at least 271.25 g/m² (8.0 oz/yd²) should be installed.
4. Soil around concrete structures
The Firestone EPDM Geomembrane liner fixed to a concrete structure must be on firm soil subgrade. Compacting of the natural soil around such structures must be performed with particular care. Backfill material around the structure shall be compacted to 95% of standard Proctor density.

2.05 Underlayment Installation

- A. Hard Substrates (concrete, treated soils, etc.)
On hard substrates such as concrete, it is always necessary to install a protection layer, unless the Firestone EPDM Geomembrane is fully adhered. On a bituminous support (bituminous concrete, bitumen emulsion stabilized soil), a geotextile of at least 271.25 g/m² (8.0 oz/yd²) or more should be used.
- B. The Firestone EPDM Geomembrane liner fixed to a concrete structure must be on firm and solid base. Compacting of the backfill soil around such structures must be performed with particular care. Backfill material around the structure shall be compacted to 95% of standard Proctor density.
- C. Installation of a geotextile between the support soil and the Firestone EPDM Geomembrane is generally recommended. It is an absolute necessity on slopes where deposition of an additional support layer is often difficult. Depending on the type of soil and roughness of the surface, the mass of the geotextile may vary between 203.43 and 508.59 g/m² (6 and 15 oz/yd²). The typical geotextile is a non woven, needle punched fabric. When the geotextile also has a drainage function, it should be checked for sufficient flow under load. There are other types of geosynthetics, such as geonets, and geonet composites that provide higher planar flow rates. Consult Firestone or geotextile manufacturer for details.
- D. If required, geotextiles are to be installed with an overlap of at least 304.8 mm (12".0). Alternatively, the overlaps may be thermally welded at an overlap of 101.6 mm (4.0"). To avoid any wind uplift, the geotextile should be temporarily ballasted.



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2.06 Firestone EPDM Geomembrane Installation

- A. The panels are unrolled and/or unfolded into the position indicated on the layout plan.
- B. Generally, side slope panels are placed and temporarily ballasted (sand bags or tires) first, followed by the bottom panels.
- C. The Firestone EPDM Geomembrane panels are unrolled from the anchor trench down the side slopes and the geomembrane is temporarily anchored to avoid movement down slope.
- D. No rocks or sharp objects are allowed under the geomembrane during placement. Damage to the supporting soil or geotextile underlayment must be avoided and must be repaired.
- E. The side slope panels should extend a minimum of 0.91 m (3.0') out onto the pond bottom for connecting with adjoining panels.
- F. All Firestone EPDM Geomembrane panels must be allowed to relax at least 30-45 minutes before seaming or attachment to structures.
- G. To avoid movement and wind uplift of the Firestone EPDM Geomembrane during installation, a temporary ballast (sand bags) is recommended. Such ballasting also facilitates the seaming operations.

2.07 Firestone EPDM Geomembrane Lap Seaming

- A. The seaming of adjacent panels should be performed immediately after the relaxation of the Firestone EPDM Geomembrane.
- B. All panels must be installed without tension and without wrinkles overlapping by at least 101.6 mm (4.0"). All seams on side slopes must be parallel with the slope (i.e., up and down the slope). Horizontal field seams on slopes are not allowed.
- C. For soft or rough subsoils a board or piece of conveyor belt is used under the Firestone EPDM Geomembrane in the area of the seam. The seaming board is moved by means of a rope as the seaming process progresses.
- D. Seams should not be made under the following conditions:
 - 1. Moisture
 - 2. Soft subgrade soil
 - 3. Condensation on the primer or on the geomembrane
 - 4. Rainfall
 - 5. Ponded water
 - 6. Excessive wind/dusty conditions
 - 7. Other contaminants
- E. Moisture in the seam will cause failure of the seam.
- F. Use only Firestone approved products. Non-Firestone products cannot be approved to make seams and will void any warranties.
- G. Clean the seam area with water and dry before applying the QuickPrime™ Plus, if it is contaminated (mud, etc.).



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- H. Stop the application of the QuickSeam™ Tape and FormFlash™ when the atmospheric conditions are unfavorable (humidity, condensation on the QuickPrime Plus or rain).
- I. Movement of the Firestone EPDM Geomembrane during application of the QuickSeam Splice Tape and during the first few minutes after application should be avoided.
- J. Positioning of a large number of panels than can not be seamed together in one day is not allowed.

2.08 Firestone EPDM Geomembrane Seaming Procedures

- A. 6.0 inch (150mm) wide cover strip tape seaming system:
 - 1. Position the Firestone EPDM Geomembranes
 - a. Both adjacent panels are positioned with sufficient overlap 101.6 mm (4.0").
 - b. The panels should lay flat and without any tension.
 - 2. Clean the Overlap

If there is dirt in the overlap area, clean the overlap area using a broom, air blower or clean cotton cloth. Soil should not be allowed to contaminate the Firestone EPDM Geomembrane in the splicing area.
 - 3. Apply the QuickPrime
 - a. Stir the QuickPrime Plus before and during use and transfer a small quantity 1.5 L (0.4 gal) to a bucket. The Primer is applied with a scrubbing pad.
 - b. Immerse the scrubbing pad in the QuickPrime Plus, keeping the pad horizontal and let excess of QuickPrime Plus drip off the pad.
 - c. Each pad immersed in QuickPrime Plus will cover an area of about 30.91 m (3.0') in length, over a width 101.6 mm (4.0") one side.
 - d. Change scrubbing pads every 60.96 m (200.0') or when the primer has dried on the pad. Used pads are to be discarded at the end of the working day.
 - e. Additional priming is required at factory seams, at the intersection of two seams and to areas covered with adhesive.
 - f. Both sides to be seamed are treated simultaneously so as to obtain an identical drying time.
 - g. Prime a minimum of 76.2 mm (3.0") on either side of the overlap edge.
 - 4. Test QuickPrime Plus for Readiness (use the touch-push method)

Allow the primer to flash off. The primer needs to dry completely (approximately 5-10 minutes) before installing the tape. Check its dryness by touching the primed surface with a clean and dry finger to be certain that the primer does not string. When touching the primer, push forward on the primed surface at an angle to ensure that the primer is dry through out its thickness. If either motion exposes a stringy primer when the finger is lifted, then the splice is not ready for installing the tape. Flash-off time will vary depending on ambient air conditions (relative humidity, wind...).



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5. Install the QuickSeam Cover Strip
 - a. Place the roll of QuickSeam Cover Strip on the ground a few feet ahead of the overlap starting point, positioned so that it unrolls from the top of the roll (release paper will be on top).
 - b. Starting a minimum of 76.2 mm (3.0") ahead of the edge of the panel, center the QuickSeam Cover Strip roll on the overlap edge and unroll onto the clean and primed surface.
 - c. Advance the roll keeping the cover strip centered over the overlap edge. Peel the release paper as you apply the cover strip.
 - d. When it is necessary to cover a longer overlap edge than the length of one roll of cover strip, it is required to overlap the next roll a minimum of 25.4 mm (1.0") onto the installed roll before continuing to unroll the second roll. When the end of the overlap is reached, extend the cover strip 76.2 mm (3.0") before cutting.
 6. Roll the QuickSeam Cover Strip
Apply pressure along the entire length of the cover strip by hand to completely mate the two surfaces. Using a 38.1 mm (1.5") wide silicone rubber roller, roll the QuickSeam Cover Strip with positive pressure towards the outside edge then along the entire length of the cover strip.
 7. Install Cover Strip at the End of Seaming Runs or "T" Joints
 - a. At the 25.4 mm (1.0") laps of the cover strip it is required to install a 304.8 mm (12.0") long section of cover strip parallel with the lap edge and centered over it. Before installing the cover strip, the area to be covered must be cleaned and primed in the normal fashion.
 - b. When cover strips intersect at any point, a 304.8 mm (12.0") long section of cover strip shall be installed centered over each T-joint area.
 - c. Round the corners on the 304.8 mm (12.0") section and then install it onto the dry primed area. Roll with the silicone rubber roller in the same manner as done to the cover strip.
 8. Special Considerations- End Laps, "T" Joints, etc
 - a. End Laps:
When the splice is greater in length than the QuickSeam Cover Strip, the adjoining 152.4 mm (6.0") QuickSeam Cover strip must be overlapped a minimum of 25.4 mm (1.0")- See Detail PG 19.
 - b. "T" Joints:
Apply a section of Firestone QuickSeam Flashing or QuickSeam Joint Cover over the "T" joint area.
- B. Overlapped Inseam Double Faced Tape System (alternative to 152.4 mm (6.0") wide cover strip tape seaming system)
1. Position the Firestone EPDM Geomembrane
 - a. Both adjacent panels are positioned with a minimum overlap of 101.6 mm (4.0").
 - b. The panels should lay flat and without any tension.



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- c. A marker is used to indicate on the lower sheet the exact location where the splice tape is to be installed.
- d. The mark shall be situated between 10.16 and 20.32 mm (0.4" and 0.8") from the edge of overlapping sheets, and is repeated every 0.91 m (3.0') of seam length.
2. Tack-back the Overlap
 - a. The upper Firestone EPDM Geomembrane panel edge is folded back 254.0 mm (10.0") and the fold is tacked down every 0.91 m (3.0') with QuickPrime Plus.
 - b. If there is dirt in the overlap area, clean the overlap area using a clean cotton cloth soaked in QuickPrime Plus. Soil should not be allowed to contaminate the Firestone EPDM Geomembrane in the splicing area.
3. Apply the QuickPrime
 - a. Stir the QuickPrime Plus before and during use and transfer a small quantity 1.5 L (0.4 gal) to a bucket. The Primer is applied with a scrubbing pad.
 - b. Immerse the scrubbing pad in the QuickPrime Plus, keeping the pad horizontal and let excess of QuickPrime Plus drip off the pad.
 - c. Apply the QuickPrime Plus uniformly along the length of the overlap seam area, with long back and forth strokes, both to the lower face of the top sheet and the upper face of the lower sheet, until the surfaces become a dark gray in color. Avoid traces and wet spots. Each pad immersed in QuickPrime Plus will cover an area of about 0.91 m (3.0') in length, over a width of 101.6 mm (4.0") one side.
 - d. Change scrubbing pads every 60.96 m (200.0') or when the primer has dried on the pad. Used pads are to be discarded at the end of the working day.
 - e. Additional priming is required at factory seams and at the intersection of two seams.
 - f. Both sides to be seamed are treated simultaneously so as to obtain a similar drying time.
 - g. Test QuickPrime Plus for readiness. Allow the primer to flash off. The primer needs to dry completely (approximately 5-10 minutes) before installing the tape. Check its dryness by touching the primed surface with a clean dry finger to be certain that the primer does not string. When touching the primer, push forward on the primed surface at an angle to ensure that the primer is dry throughout its thickness. If either motion exposes a stringy primer when the finger is lifted, then the splice is not ready for installing the tape. Flash-off time will vary depending on ambient air conditions (relative humidity, wind...).
4. Install the QuickSeam Splice Tape
 - a. Apply the QuickSeam Splice Tape (with release paper intact) on the bottom sheet, aligning the edge of the release paper with the markings.
 - b. Immediately roll the splice with a 101.6 mm (4.0"), wide silicone sleeved hand roller or other methods to achieve 100% bond area.



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- c. When it is necessary to start a new roll of tape to continue seaming, it is required to overlap the installed tape by 25.4 mm (1.0") minimum before unrolling the second roll.
5. Check the QuickSeam Splice Tape Alignment
 - a. The Firestone EPDM Geomembrane is released and the seam is closed by hand. To avoid wrinkling, close the splice gently with a movement perpendicular to the splice. The upper sheet must fall without wrinkling or tension onto the lower sheet. Allow the top sheet to rest on top of the tape's paper backing.
 - b. Trim the top sheet as necessary to assure that 10.16 to 15.24 mm (0.4" to 0.6") of the QuickSeam Splice Tape will be exposed on the finished splice.
6. Remove the Paper Backing
 - a. To remove the paper backing from the tape, first roll back the upper Firestone EPDM Geomembrane panel over the installed QuickSeam Splice Tape. Peel the paper backing off the QuickSeam Splice Tape by pulling against the weight of the bottom sheet at approximately a 45° angle to the tape.
 - b. Allow the top sheet to fall freely onto the exposed QuickSeam Splice Tape. Mate the entire length of the seam as the release paper is being removed.
7. Roll the Overlap Seam
 - a. Finally, roll the seam area by means of a 38.1 mm (1.5") silicone rubber roller, first across the splice and then along the entire length of the splice.
 - b. For uneven or soft subgrades, a seaming board is required directly under the seam area. The seaming board is moved as the seam is completed.
8. Install QuickSeam Joint Covers or QuickSeam Cover Strip at the End of Seaming Runs and "T" Joints
 - a. Install a 146.05 mm (5.75") QuickSeam Joint Cover over end laps or T-joints. Before installing the Joint Cover, the area to be covered must be cleaned and primed in the normal fashion. Roll the Joint Cover with the roller in the same manner as the overlap seam.
 - b. At 25.4 mm (1.0") laps in the seam tape it is required to install a 152.4 mm x 152.4 mm (6.0" x 6.0") section of cover strip centered over the seam edge and over the lap. Before installing the cover strip, the area to be covered must be cleaned and primed in normal fashion.
 - c. Trim seam so that the edge of seam tape and the edge of the geomembrane are flush beneath the T-joint area. Apply a 228.6 mm (9.0") long section of cover strip centered over the seam step-off.
 - d. Round the corners of the cover strip section and then install it onto the dry-primed area. Be sure to center the cover strip so that it extends 76.2 mm (3.0") in each direction from the center of the overlap and the edge of the seam. Roll with the roller in the same manner as done with the overlap seam.



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9. Special Considerations- End Laps, "T" Joints

a. End Laps:

When the splice is greater in length than the QuickSeam Cover Strip, the adjoining 152.4 mm (6.0") QuickSeam Cover strip must be overlapped a minimum of 25.4 mm (1.0")- See Detail PG 19.

b. "T" Joints:

- 1) Apply a section of Firestone QuickSeam Flashing or QuickSeam Joint Cover over the "T" joint area.
- 2) After the primer has dried, apply a continuous bead of Lap Sealant .52 mm x 6.35 mm (0.375" x 0.25") around the cover strip section edge. Using the supplied Lap Sealant tool, feather the Lap Sealant immediately, taking care to leave a mound of sealant directly over the cover strip section edge.

2.09 Geomembrane Termination

The Firestone EPDM Geomembrane must be restrained in place to prevent movement down the slope and/or by wind. Depending on the situation, the Firestone EPDM Geomembrane may be anchored at various locations (i.e. top of embankment, toe of slope, or at an intermediate bench). If considerable settlement or movement is expected when the pond is filled, temporary ballasting should be provided at the top of embankment. The ballasting must allow for geomembrane movement with regard to the settlement but needs to be of an amount to prevent the geomembrane from sliding down the slope.

A. Top Anchoring the Firestone EPDM Geomembrane

1. The top of the slope should be rounded to provide a smooth transition for the liner to reduce stress. An anchor trench must be excavated around the entire perimeter of the impoundment. The excavated soil material can be placed next to the trench for backfilling after Firestone EPDM Geomembrane placement. The anchor trench should be a minimum of 0.91 m (3.0') back from the top of slope. The edge of the trench should be rounded and free of protrusions to reduce stress on the Firestone EPDM Geomembrane.
2. If considerable soil movements are expected during the filling of the pond, temporary anchoring should be provided at the crest so that the Firestone EPDM Geomembrane underlayment can move without being subjected to excessive tension. Partial ballasting in the anchor trench is immediately provided and final backfill is done at a later stage. To avoid movement and wind uplift of the Firestone EPDM Geomembrane during installation, temporary ballast (sand bags) is recommended. Such ballasting also facilitates the seaming operations.
3. The Firestone EPDM Geomembrane must be kept in place to prevent down slope movement and/or wind uplift. Depending on the situation, the Firestone EPDM Geomembrane may be anchored in various ways, at the top of the embankment, at the bottom, or at an intermediate bench.



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4. The top of slope anchors can be accomplished by burying the Firestone EPDM Geomembrane in a trench or by holding it in place through soil backfilling or ballasting. The dimensions of the trench depend on the expected stress. The minimum section should be 0.30 m (1.0') wide x 0.40 m (1.3') deep in cohesive soil, depending on the length (L) of the Firestone EPDM Geomembrane liner between two anchor points, the distance between the top anchor trench and the water level, the wind speed, etc. The top of the slope should be rounded to provide a smooth transition for the liner to reduce stress.
5. The Firestone EPDM Geomembrane should extend on the bottom of the trench over at least 304.8 mm (12.0") and up the back of the trench 152.4 mm (6.0").
6. The following table shows some approximate values for the trench section in compacted cohesive soil. However, it is recommended to calculate pullout requirements, especially for soil covered slopes, based on industry design standards.

Table 2.1

LENGTH OF SLOPE		SECTION OF TRENCH (M ²)			
M	F	Low or medium wind		High wind speed	
		< 100 km/h	< 62 mph	> 100 km/h	> 62mph
< 3	10	0.12	1.5	0.12	1.5
3-5	10-15	0.12	1.5	0.12	1.5
5-15	15-50	0.12	1.5	0.25	2.75
15-40	50-130	0.25	2.75	0.36	4.0
>40	> 130	0.36	4.0	0.49	5.25

7. As an alternative, using ballast at the top of the slope on a flat runout is possible if necessary measures are taken for the ballast not to erode over time.
- B. Intermediate Anchors**
1. If the embankment is high, it may be necessary to provide an intermediate anchor to accommodate the potential for Firestone EPDM Geomembrane movement. A bench may be added to the incline in order to provide slope stability of the embankment.
 2. The Firestone EPDM Geomembrane should be held in place by ballast, anchor trench, or cover soil.
- C. Toe of Slope / Bottom Ballast**
- In some cases, especially on large reservoirs, temporary and/or permanent ballast (soil cover) may be required due to operating conditions or wind conditions. Additionally and especially on embankments, or dam facings, toe of slope anchor trenches maybe required.
- D. Inflow Terminations**
- In some cases, especially on reservoirs, and canals the point where the water enters the lined area must have proper termination. The area of inflow must be anchored



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with a trench of a depth designed by the project engineer. The membrane installed and then anchored with concrete prior to the covering with soil (see detail).

2.10 Terminations

A. Flashing Walls

1. Connections of the Firestone EPDM Geomembrane to concrete/masonry structures shall comply with the following:
 - a. Soil around the concrete/masonry shall be compacted to 95% standard Proctor density
 - b. Connection surfaces shall be smooth, clean and free of any sharp protrusions
 - c. Firestone EPDM Geomembrane shall be fully adhered to the walls using bonding adhesive or splice adhesive as required
 - d. Corners are installed with QuickSeam Corner Flashings or by using QuickSeam FormFlash.
 - e. The detail of the Firestone EPDM Geomembrane connection with the wall shall not permit any leakage
 - f. Firestone EPDM Geomembrane is fastened at the ends or top using termination bars and fasteners adapted to concrete/masonry. Firestone Water-Block sealant is placed between the Firestone EPDM Geomembrane and the wall as shown in Firestone details.

2.11 Flashing Penetrations

- A. In order to avoid any differential settling, the backfill around the structures should be placed in successive layers, each compacted to 95% standard Proctor density.
- B. If possible, avoid cutting the Firestone EPDM Geomembrane at details. In some cases, however, as with corner details against concrete/masonry walls, pipe connections, etc., a cut in the Firestone EPDM Geomembrane liner will simplify the installation. In such cases, Quickseam FormFlash (unvulcanized EPDM sheet) will be used to provide a tight connection when properly installed according to the manufacturer's instructions.
- C. For larger diameter pipes, connections to pipes shall be made by means of unvulcanized EPDM sheet, QuickSeam FormFlash, as follows:
 1. Pipe must be firmly anchored and the pipe wall temperature must not exceed 80° C (175° F) during service
 2. Make a circular cut-out in the Firestone EPDM Geomembrane, measuring approximately 80% of the pipe diameter
 3. Pull the Firestone EPDM Geomembrane over the pipe
 4. Pipe and Firestone EPDM Geomembrane are sealed by means of a piece of QuickSeam FormFlash.
 5. Mechanically secure the connection with a marine grade stainless steel clamping collar
 6. Firestone EPDM Geomembrane must be adhered to concrete/masonry thrust blocks with bonding adhesive.



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D. Bottom Drains

1. The Firestone EPDM Geomembrane shall be mechanically fastened at the location of water discharge.
2. This detail requires the installation of a concrete base at the location of the drain.

2.12 Firestone EPDM Geomembrane Repair and Maintenance Procedures

- A. A small tear or hole in the Firestone EPDM Geomembrane may be repaired by placing a piece of the 152.4 mm (6.0") cover strip over the area to be repaired with a of 76.2 mm (3.0") extending all directions beyond the repair. The patch must be round, oval, or contain rounded corners.
- B. 152.4 mm (6.0)" Diameter QuickSeam Joint Cover patches may also be used.
 1. Small holes, < 6.35 mm (0.25 inch), may be repaired using the 6 inch diameter QuickSeam Cover Patch.
 2. Clean the damaged area by scrubbing with a cloth soaked in QuickPrime Plus. The surface should be dark gray in color with no streaking. Allow the area to dry.
 3. Repair the larger tears or holes by cutting a piece of Firestone EPDM Geomembrane that extends beyond the tear or hole by a minimum of 101.6 mm (4.0") extending all directions beyond the repair. Tape all edge seams as per Section 2.08- 152.4 mm (6.0") wide cover strip seaming tape system.
- C. An annual inspection of the installation is recommended to detect any problems which may occur. This inspection process will limit costs if damage has occurred.
 1. Visual inspection of the Firestone EPDM Geomembrane, splice connections and the anchoring.
 2. Measurement of the leak flow rate and monitoring of water level.
 3. Check all gas drainage vents.
 4. Avoid any overflowing of the pond.
 5. Check the chemical composition and the temperature of the liquids coming into contact with the Firestone EPDM Geomembrane.
 6. Check the protection of the sheet, if any.

2.13 Seam Test Procedures

- A. Test Seam or Trial Seam – Destructive Mechanical Testing
 1. At the start of a shift or at the beginning of each day, the seaming crew should complete a trial seam of approximately 3.05 m (10.0') in length.
 2. From the trial seam, 25.4 mm (1.0") wide strips are cut for testing on a field tensometer - 3 in peel and 3 in shear. Shear and peel tests are carried out in general accordance with ASTM D413 and D7272 with the strain rate of 500 mm/min (20 in/min) for both peel and shear due to the elastometric properties of Firestone EPDM Geomembranes. Trial seam test strips should be allowed 24 hours of cure time.
 3. The minimum requirements are as follows:
 - a. Shear: 6.15 kN/m (35 lb/in) at 200% strain.



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- b. Peel: 2.11 kN/m (12 lb/in) in cohesive bond mode.
- 4. The same minimum requirements can be expected for specimens taken from a destructive field seam cut out when required.
- B. Non-Destructive Test (NDT) Procedure
 - 1. Air Lance Test (ASTM D4437)
 - a. Inspect all field seams for unbonded areas using an air nozzle directed on the upper seam edge and surface to detect loose edges, ripples indicating unbonded areas within the seam, or other undesirable seam conditions.
 - b. Check all bonded seams using a minimum 345 kPa (50 lb/in²) air supply directed through a 4.8 mm (0.188") nozzle, held not more than 50.8 mm (2.0") from the seam edge and directed along the seam edge.

2.14 Protection of the Firestone EPDM Geomembrane During Service

- A. Under all operating conditions, protection of the Firestone EPDM Geomembrane will be required. Table 2.2 below shows some recommendations for the protection against possible damage.
- B. Protection of the geomembrane may be realized in the following ways:
 - 1. Base
 - a. Sand bed (minimum thickness: 304.8 mm (12.0"))- protection with geotextile not required
 - b. Gravel (minimum thickness 304.8 mm (12.0"))- protection with geotextile required
 - c. Prefabricated blocks - protection with geotextile required
 - 2. Slopes
 - a. Rock covering (riprap) - This solution is applicable for slopes less than 3:1. A transition layer (geotextile plus sand bed) with a minimum thickness of 304.8 mm (12.0") is required. Rock size depends on the level of the impacting forces, such as wave height.
 - b. Prefabricated blocks - Stability investigations of prefabricated blocks and installation of a redundant layer of EPDM is required.
 - c. Cast-in-place concrete - Stability investigations and installation of a redundant layer of EPDM are required.
 - d. Shotcrete - installation of a geotextile may be required on steep slopes (>2H:1V). Additionally, wire reinforcement maybe required. (If wire reinforcement is used contact Firestone Specialty Products Department for additional protection requirements.)



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Table 2.2

Protection Against	Recommendation
Wind	<ul style="list-style-type: none"> • Ballast at the bottom or on slopes • Correct section of anchor trench depending on pullout calculations
Waves	<ul style="list-style-type: none"> • Mechanical protection of the embankments depending on slope (rock covering, concrete pavement, cast-in-place-concrete)
Floating objects (dead wood, debris)	<ul style="list-style-type: none"> • Small ponds: cleaning • Large ponds: protection of side slopes
Ice	<ul style="list-style-type: none"> • Mechanical protection of embankments
Animals	<ul style="list-style-type: none"> • Ladders • Fence around reservoir • Geotextile under the Firestone EPDM Geomembrane on slopes
Vandalism	<ul style="list-style-type: none"> • Enclosure around reservoir • Mechanical protection of embankments
Operating vehicles	<ul style="list-style-type: none"> • Protection of the Firestone EPDM Geomembrane with soil or a sand bed (min. 18 in (450mm)) • Access ramp protection of embankments
Local turbulence with water velocity exceeding 4 ft/sec (1.2 m/sec) (internal agitator or canals)	<ul style="list-style-type: none"> • Protection with designed cover system or ballast

2.15 Warranty

- A. Upon inspection and acceptance of the installed Firestone EPDM Geomembrane System, the requested warranty shall be issued. Only Firestone supplied components are covered by the Firestone warranty.
- B. See Warranty Section for a listing of available Firestone warranties for Firestone EPDM Geomembrane installations.