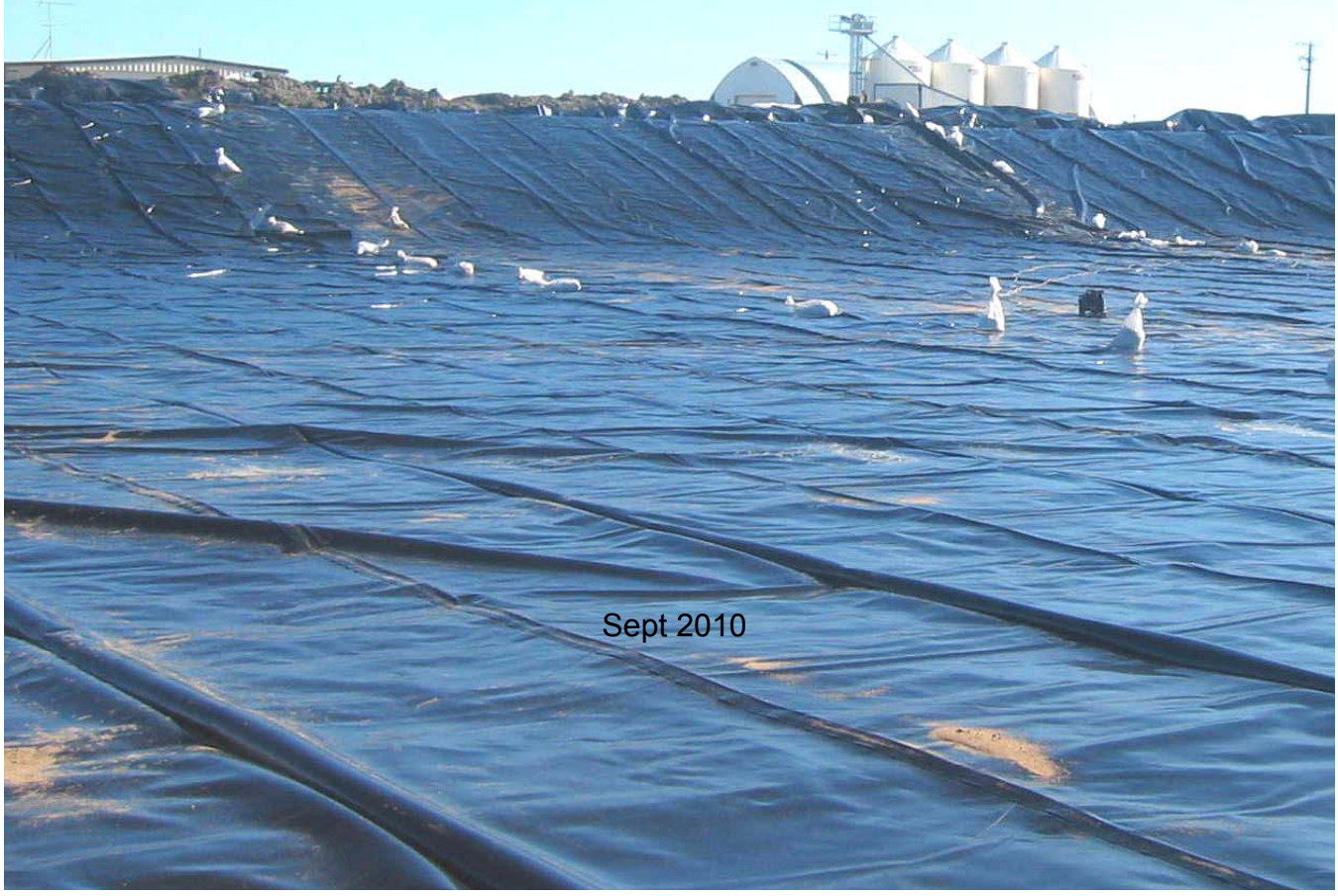
Global
PLASTIC SHEETING

GEOMEMBRANE INSTALLATION GUIDELINES

RUFCO® 20, 30 & 40 MIL UNREINFORCED

DURA♦SKRIM® 30, 36 & 45 MIL REINFORCED



Sept 2010

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Membrane Installation

SCOPE: The following instructions are intended as guidelines for the installation of Global Plastic's 20, 30 & 40 mil unreinforced geomembranes and Dura-Skrim J30, K36 and K45 mil geomembranes. However, it is vital that individual engineer's detailed specifications and procedures are followed.

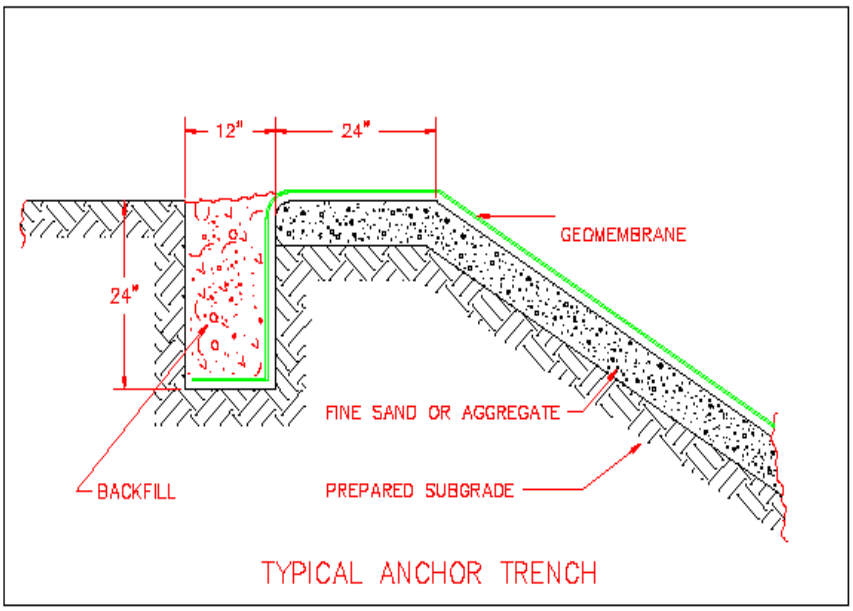
1.0 Subgrade Preparation

1.1 The foundation area for flexible membrane liners shall be smooth and free of projections that might damage the liner. All stumps and roots shall be removed. Rocks, hard clods, coarse gravel and other such material shall be removed or shall be rolled so as to provide a smooth surface or shall be covered with a cushion of fine soil. Subgrade must be compacted to comply with design specifications and include a stable base to support equipment and necessary vehicle weight and shall be free of standing water.

1.2 An effective sterilant shall be applied to the subgrade at the rate recommended by the manufacturer, if installing on soil where seeds and/or plant roots are present.

1.3 The foundation area should be sloped if there is a possibility of gas pressure buildup (through organic decay or water table fluctuations). A slope of not less than 1.5% is required. A venting medium, either geotextile or sand, is to be placed over the entire bottom and sides slopes. Venting to the atmosphere will be through vents placed as required for local conditions.

1.4 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 24 inches deep and about 12 inches wide, or according to the specifications of the design drawing. Care shall be taken when constructing the trench to avoid construction equipment from coming in direct contact with the geomembrane liner.



2.0 Panel Layout

2.1 A layout drawing must be produced by the installer that specifies panel configuration and field seam location(s).

3.0 Identification and record keeping

3.1 **Record Forms:** Proper documentation must be kept in a record form containing the following information:

3.2 **Panel Layout**

(A) Each panel shall be assigned a numeric or alpha-numeric identifier.
(B) Panel configuration, showing factory seams and field seam location.

3.3 **Identification**

(A) Product type
(B) Panel identification number. (from label with bar code)
(C) Manufacturing date. (from label with bar code)

3.4 **Field Seaming**

(A) Welding equipment model and identification number
(B) Welding Technician Name
(C) Temperature control settings
(D) Date
(E) Time
(F) Location
(G) Ambient temperature

3.5 **Seam Test Results**

(A) Vacuum test settings (typically used for extrusions welds and repairs)
(B) Air pressure test settings (typically used for double track welds)
(C) Seam Strength results

4.0 Location

4.1 Panels are to be placed in their respective locations as specified by the layout drawings. An as-built drawing must be completed indicating actual panel placement, seams and patches.

5.0 Weather Conditions

5.1 Unacceptable conditions for panel installation include: precipitation or the presence of any standing water, high winds, or extreme temperatures. Ideal installation air

temperatures should range between 40ºF and 90ºF. During extremely warm or cold temperatures it is recommended that frequent trial seams are made and evaluated to ensure that the welders are properly set up for the conditions.

6.0 Method of Installation

6.1 The method, personnel, and equipment used for panel installation must not damage the membrane or the supporting subgrade surface. All installers must wear non-damaging footwear. Smoking or any action that may result in damage to the geomembranes in any way will not be allowed. Proper repair procedures must be followed should any damage occur.

6.2 Panels should be positioned to minimize handling and to allow enough slack to compensate for shrinkage.

7.0 General Field Seaming Requirements

7.1 There are several different types of field welding equipment available. The most common are fusion welding and extrusion filet welding. Sewing, taping, gluing and solvent welding are not acceptable for field seaming unreinforced geomembranes. Extrusion welding is preferred for repairs, patching and installing pipe boots.

7.2 Welding Equipment

(A) Fusion welding consists of placing a self-propelled hot wedge or hot air welder between two overlapped panel edges. The welders heat and melt the surface of the geomembrane and then compress the material between two rollers where the combination of heat and pressure creates a fusion weld.

(B) Extrusion fillet welding consists of extruding a bead of molten resin along the edge of a panel lapped on top of another panel. The molten resin causes the melting of each sheet, which results in a homogeneous bonding of the panels. The polyethylene rod used for welding must be compatible with the liner material.

7.3 Seaming Personnel

7.4 All personnel performing seaming operations must be trained on the specific equipment to be used, and the seaming techniques recommended by the equipment

manufacturer. A project foreman must supervise all personnel to insure proper seaming procedures are followed.

7.5 Seaming Procedures

7.6 Welders must be set up and adjusted per welder manufacturer requirements. Welders must be allowed to heat up as specified by the welder manufacturer. Extrusion fillet welders must be purged of degraded material before use. Monitor and maintain proper edge overlap and operating temperature of the sealing apparatus during the seaming process.

(A) Seam Preparation

1 Overlap panel edges a minimum of four (4) inches, or as specified by the welder manufacturer. Extrusion fillet welding requires six (6) inch overlap.

2 Seal defects must be repaired; “fish mouths” must be trimmed, laid flat and patched.

3 Clean the welding surfaces prior to welding to assure the seam is free of moisture, dust, dirt, or any debris.

4 For extrusion fillet welding the surfaces do not need to be abraded (roughened). If surfaces are cleaned by abrading; be careful not to abrade too much and damage the material. If damage occurs the proper repair technique must be followed.

8.0 Destructive Seam Test

8.1 Make test runs of the seams before beginning actual production seaming in order to make sure equipment is setup correctly. These tests should be run at least every five (5) hours. Note: These are clock hours, not operating hours.

8.2 Test Seam Description

8.3 Test seams shall be performed using pieces of liner long enough for the welder temperatures to stabilize. Follow the welder manufacturer’s recommendations. At a minimum, fusion welded seam samples will be 10 feet long and extrusion welded seams 3 feet long. Cut test specimens from the end of the test seams. Test seams must be made under the same conditions as the actual sealing process.

8.4 Peel Test Procedure

(A) Unless otherwise required, only seam peel tests need to be done in the field. For unreinforced geomembrane seam peel should be tested in accordance with ASTM D 6392 using the 90º T-peel method. Test five samples one inch wide,

pulled at a rate of 20 inches/minute using a field tensiometer. The failure must be a film tear bond (FTB). A FTB is failure of one of the parts of a ply by tearing, instead of separating from the other part of the specimen in a peel type failure. Samples that do not fail within the stroke of the field tensiometer and elongate more than 50% may be considered passing.

Unless otherwise required, 4 passing samples out of 5 will be acceptable. If more specimens fail in a peel type mode, the procedure shall be repeated using another set of samples. If the second set of specimens fails, the welding procedure shall not be accepted until the deficiencies are corrected and a passing seam is achieved. See the procedure for removal of bad seams in Section 10.6. Documentation of test seams must list: peel failure mode, welding machine number, welder's name, time, date and temperature control setting.

For reinforced geomembranes seal test should be performed per ASTM D4437-99.

9.0 NON-DESTRUCTIVE SEAM TEST

9.1 100 Percent of the field seams will be tested for leaks. The preferred test methods are vacuum box and air pressure testing

9.2 **Vacuum Test Equipment:** The vacuum box consists of a rigid housing with a clear viewing window, soft neoprene gasket, valve assembly, vacuum gauge, pressure controlled vacuum pump, and container of soapy solution. Vacuum box and procedures should be in accordance with ASTM D-5641.

9.3 **Vacuum Testing Procedure**

(A) Trim excess overlap from seal, if any, and apply a generous amount of soapy solution to test area.

(B) Place the box over the area and press downward to "seat" the gasket strip against the liner to ensure a leak tight seal.

(C) Close the bleed valve and open the vacuum valve. Apply a minimum of eight inches of Hg. (4 PSI.) vacuum.

(D) Monitor, at least 10 seconds, for air bubbles forming on the inside of the gasket.

(E) If no bubbles appear after 10 seconds, close the vacuum valve and open bleed valve. Continue along the seam maintaining at least a three (3) inch overlap between test areas. All field seams and repairs must be inspected in this manner except for seams that can be tested using the air pressure method.

(F) If bubbles appear, mark all areas and follow proper repair procedures before rechecking.

(G) Record test data including: date of seam fabrication, date of test, ambient

temperature, typical vacuum pressure, hold duration, foaming solution, and location and size of all defects

NOTE: 1 inch of Hg. (mercury) = .5 P.S.I.
1 Bar = 14.5 P.S.I.
1 P.S.I = 6.8 kPa

9.4 Air Pressure Testing

The wedge welded seam process creates a hollow channel approximately 3/8 of an inch between the two weld seal. The sealed channel is inflated to a predetermined air pressure and is observed over a period of time for stability. This test should be performed in accordance with ASTM D-5820

9.5 Air Pressure Testing Equipment

(A) An air pump capable of generating and sustaining pressures up to 30 P.S.I. is required.

9.6 Air Pressure Testing Procedure

(A) Seal both ends of the seam to be tested and insert a pressure feed device into sealed channel. Unless other requirements are given the following pressures and times may be used. Inflate to a pressure in accordance with the following chart, close valve, and observe the initial pressure after 2 minutes

(B) **Initial Pressure**

Material (Mil)	Min. PSI	Max. PSI	PSI Diff.
20-45	20	25	4

NOTE: If gauges are in bars use 1 Bar = 14.5 P.S.I.

(C) Initial pressure settings are read after a two minute relaxing period. The air is given time to stabilize during the period.

(D) Observe and record the air pressure 5 minutes after the relaxation period ends. Subtract this pressure from the initial pressure and compare it to the allowable maximum pressure difference listed in the initial Pressure Chart. (See 9.6 B). If pressure does not stabilize, locate and repair the faulty area. At the conclusion of the pressure test the end of the seam opposite the pressure gauge is cut. A decrease in the gauge pressure must be observed or the channel will be considered blocked and the test will have to be repeated after the blockage is removed.

(E) Remove the pressure feed device and seal the resulting hole by extrusion welding.

(F) Record test data including: date of seam fabrication, date of test, ambient temperature, inflation pressure, hold duration, pressure after hold, and location and size of all defects

10.0 **Defects and Repairs**

10.1 All defects and repairs must be marked, repaired, and documented. A complete search must be conducted throughout the entire surface of the geomembrane. Defects may consist of holes, snags, or any penetrations.

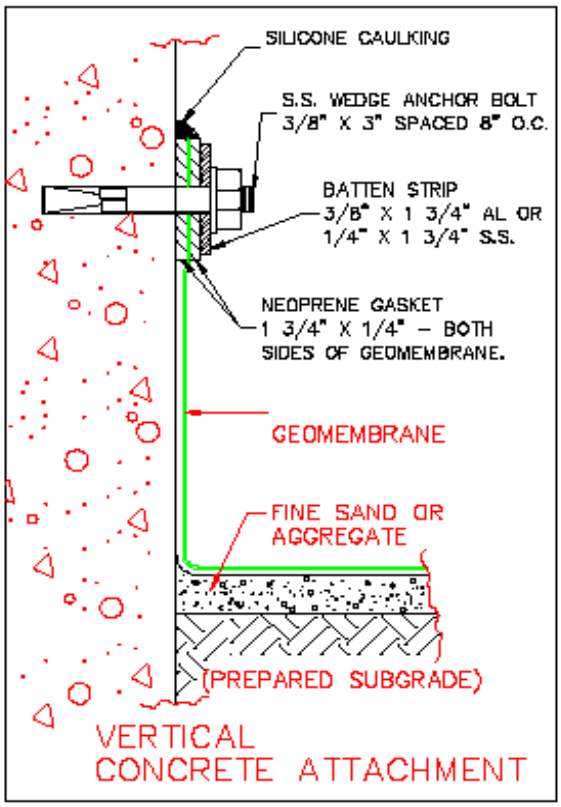
10.2 Small holes or snags 1/4" in diameter or less, may be repaired using the extrusion welding process.

10.3 Large holes or tears larger than ¼” in diameter must be repaired by “overlaying” a patch consisting of the geomembrane itself. This patch must extend beyond the damaged area by at least 6” in every direction. The patch shall have all corners rounded with at least a 1 ½ inch radius for ease of extrusion welding.

10.4 The patch shall be "spot welded" in place and extrusion welded around the entire perimeter.

10.5 All extrusion weld repairs must be vacuum tested to assure a proper repair (See 9.3).

10.6 Removal of bad seams shall be repaired in the same manner as large holes. The defective seam shall be removed and patched with an overlay patch and extrusion welded.



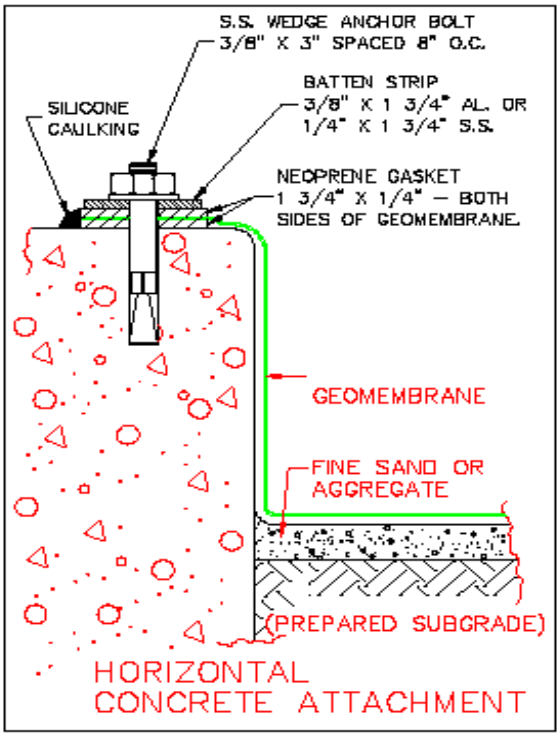
11.0 Suggested Attachment to Concrete

11.1 ASTM D 6497 also provides valuable attachment information. Concrete attachment areas shall be designed with rounded edges and prepared with as smooth of a surface as possible.

11.2 Horizontal attachments to concrete are preferred over vertical attachments if possible.

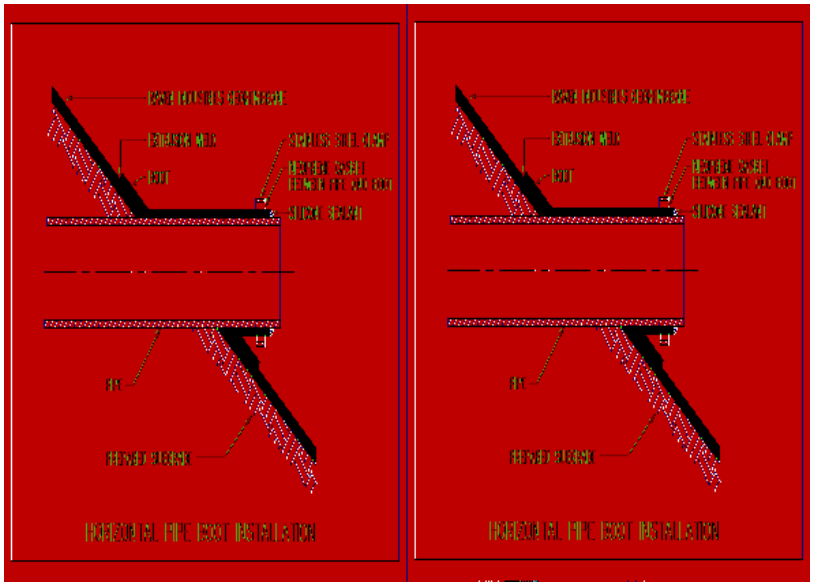
11.3 At the attachment point the geomembrane shall be sandwiched between two neoprene gaskets 1/4" thick x 1 1/2" wide and capped with a 1 3/8" wide x 1/4" thick stainless steel batten strip, or a 1 3/8" wide x 3/8" thick aluminum batten strip.

11.4 Gaskets, geomembrane, and batten strip may be attached with 3/8" Dia. x 3" long wedge type stainless steel anchor bolts 8" on center. The top edge of the gaskets and geomembrane should be caulked with a General Electric Sealer, RTV 103, or equivalent to prevent seepage behind liner. If for strictly fastening purposes only, a pressure treated wooden batten strip (2" x 4") attached to concrete by stainless steel power nails 12" on center is acceptable.



12.0 Pipe Boot Attachment

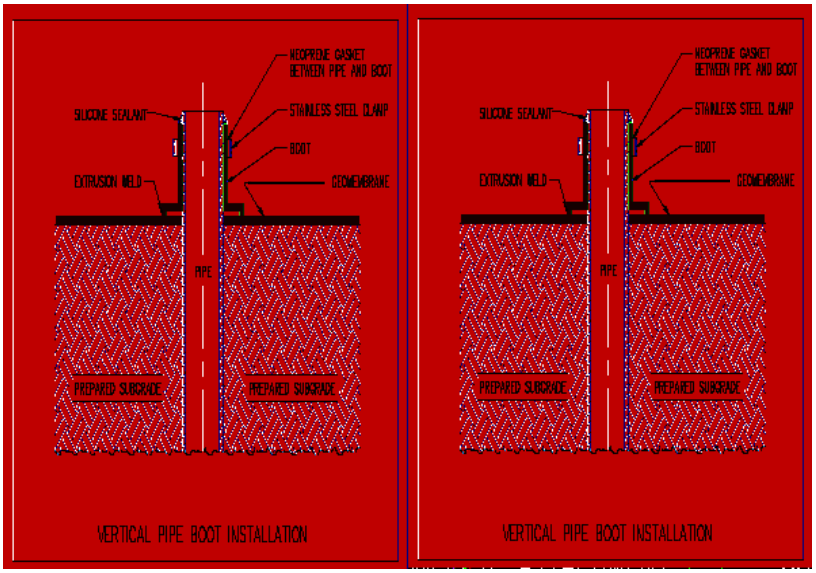
12.1 ASTM D 6497 also provides valuable attachment information. Pipe boots can be fabricated from the geomembrane. Fabrication and attachment of the boot to the geomembrane should be done with the extrusion welding process.



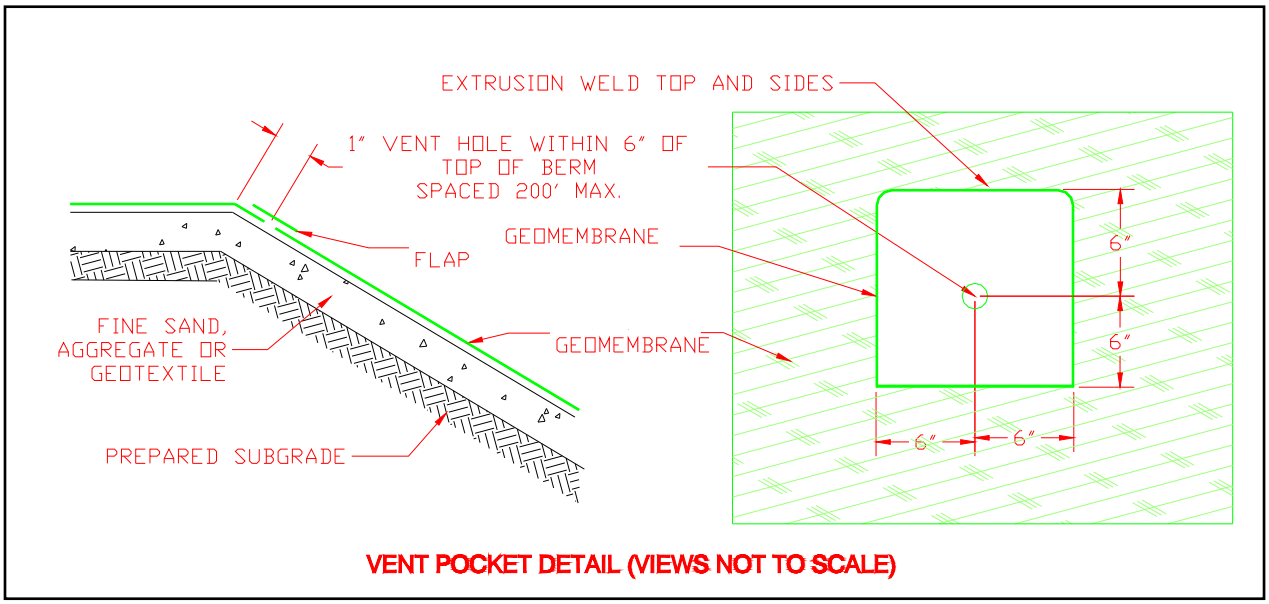
12.2 The geomembrane should be sealed to the pipe with a neoprene gasket and a stainless steel clamp sealed on the edge of the geomembrane with a General Electric Sealer, RTV 103, or equivalent.

NOTE:

The types of mechanical fastening will vary with the application and project. The attached drawings only demonstrate a general standard method. Strict compliance with the design engineer's specifications and recommendations is vital.



13.0 Pocket vents may be installed to allow air trapped under the geomembrane during installation or gasses given off by certain soil types to escape.



Panel Layout Log

Project Name: _____ Site Manager: _____
Location: _____ Material: _____
Job Number: _____ Thickness_____
Deployment Date: _____

Panel Number	Roll Number(s)	Manufacturing Date	Width (feet)	Length (feet)

As built Drawing

Seam Log

Project Name: _____ Site Manager: _____
Location: _____ Material: _____
Job Number: _____ Thickness_____

Seam Number	Date of weld	Time seam started	Ambient temperature	Type of weld	Length (feet)	Machine Number	Temperature settings	Technician ID Number

Seam Test Log

Project Name: _____ Site Manager: _____
Location: _____ Material: _____
Job Number: _____ Thickness_____

Destructive test log								
Date of Weld	Time Started	Ambient Temperature	Type of Weld	Temperature Settings	Machine Number	Technician ID Number	**P**ass/**F**ail Peel test	Next seal Number

Non-destructive test log							
Seal Number	Test Date	Ambient Temperature	Vacuum pressure	Or	Air Pressure Test PSI Start Psi End	**P**ass/**F**ail	Repair Locations