RAVEN

INSTALL GUIDELINES

Installation Guidelines
Dura♦Skrim® N30B, N30BT1 & K30B
Interim Landfill Covers

RAVEN

DURA♦SKRIM® N30B, N30BT1, AND K30B GEOMEMBRANE INSTALLATION GUIDELINES FOR INTERIM LANDFILL COVERS

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Part 1 – General

1.01 Guideline Scope

This document is an installation guideline for Factory Fabricated Dura♦Skrim® N30B, N30BT1 and K30B reinforced interim landfill covers. This guideline is designed to provide a minimum set of standards for site installation. However, depending on the complexity and project specific requirements, a qualified design engineering firm may be required for design and installation specifications of the geomembrane cover. All work shall be in accordance with the project drawings, specifications and QC requirements.

Applications

Typical applications for Dura♦Skrim® N30B, N30BT1 and K30B geomembranes include; but not limited to:

- Interim Landfill Covers
- Temporary Rainshed Covers
- Remediation Covers or Liners
- Temporary Erosion Control
- Evaporation Covers
- Earthen Liners
- Disposal Pit Liners

Dura♦Skrim® N30B, N30BT1 and K30B are used in more demanding applications requiring high tear resistance. N30B, N30BT1 and K30B are designed to withstand longer term outdoor applications requiring up to 20 years of exposure or more demanding upon geographical location. Wind Defender ballast system can be utilized as a ballast system if approved by the design engineer.

Dura♦Skrim® N30B, N30BT1 and K30B are designed to meet the requirements of the Geosynthetics Research Institute; GRI-GM25 Standard Specification, Category 3.

1.02 References

American Society for Testing and Materials (ASTM)

1. ASTM Standards D4437. "Standard Practice for Non-destructive Testing (NDT) for Determining the Integrity of Seams Used in Joining Flexible Polymeric Sheet Geomembranes". ASTM International, West Conshohocken, PA.
2. ASTM Standards D751, "Standard Test Methods for Coated Fabrics". ASTM International, West Conshohocken, PA.
3. ASTM Standards D7004, "Standard Test Method for Grab Tensile Properties of Reinforced Geomembranes". ASTM International, West Conshohocken, PA.

4. ASTM Standards D5884, "Standard Test Method for Determining Tearing Strength of Internally Reinforced Geomembranes". ASTM International, West Conshohocken, PA.
5. ASTM Standards D4833, "Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products. ASTM International, West Conshohocken, PA.
6. FGI-4-2015: Guideline for Air Lance Testing of Field Geomembrane Seams

Other References

1. Geosynthetic Research Institute (2012). "Test Methods, Test Properties and Testing Frequency for Reinforced Linear Low Density Polyethylene (LLDPE-R) Geomembranes". GRI GM25. Geosynthetic Institute, Folsom, PA.

1.03 Submittals

Documents to be included in a submittal to the owner / engineer:

1. Example of the material warranty and geomembrane installation warranty.
2. Sample of the geomembrane to be installed including the technical data sheet.
3. Product Certification shall be prepared and submitted to the Owners Representative.
4. Shop drawings / panel layout for geomembranes with panel numbers, field seam locations, corresponding to shipping labels.
5. Submit resumes or qualifications of the installation supervisor.
6. The documentation to be submitted by the fabricator varies depending on the Owner's requirements. These may include copy of tested seams, certifications, or any other document related to the quality of the geomembranes and their installation.
7. Fabricator and Installer QC Manuals.

Part 2 – Products

2.01 Geomembrane Material

This document is an installation guideline for factory fabricated Dura♦Skrim® N30B, N30BT1 and K30B reinforced polyethylene geomembranes. The top and bottom lamination layer of the geomembranes included in this guideline will be comprised of a linear low density polyethylene (LLDPE).

The geomembrane included in this Guideline is as follows:

- 1300 Denier Scrim Reinforced Geomembrane: Dura♦Skrim® K30B geomembrane has a scrim reinforcement that has an open grid consisting of 7 stands per inch in both machine and transverse direction except in the outer 3" in from the edge of the panel. The finished K30B sheet shall be capable of being fusion welded in the factory and in the field.
- 1000 Denier Scrim Reinforced Geomembrane: Dura♦Skrim® N30B and N30BT1 geomembranes have a scrim reinforcement that has an open grid consisting of 9 stands per inch in both machine

and transverse direction. The finished N30B and N30BT1 sheet shall be capable of being fusion welded in the factory and in the field.

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2.02 Quality Control

a. Manufacturers Qualifications

The manufacturer of the specified geomembrane or similar product shall have at least five years of continuous experience in the manufacture of the geomembrane. Additionally, the Manufacturer shall have produced a minimum of 2,000,000 m2 (21,527,820 ft2) of the specified type or similar geomembranes.

b. Fabricators Qualifications

The fabricator of the geomembrane shall have fabricated a minimum of 250,000 m^2/(2,691,000 ft2/) of the specified type or similar geomembranes.

c. Installers Qualifications

The Geomembrane Installer shall be the Fabricator, approved Fabricator's Installer, or an installer/contractor approved by the Owner's Representative. The installer shall have a minimum experience level of 50,000 m2 (538,200 ft2) using the specified geomembrane.

It is the responsibility of any of the aforementioned parties to select a Geomembrane Installer with the appropriate degree of experience, personnel, and equipment to accomplish the required quality standards.

2.03 Geomembrane Arrival at Project Site

a. Geomembrane Unloading

Inspect fabricated geomembrane panels prior to unloading from vehicle at project site (e.g. type of material, conditions, etc.). Make any claims for damage with the carrier prior to unloading or shortly after geomembrane unloading.

Materials delivered to site should be off-loaded (using forklift or similar equipment) in a location where minimum handling steps will be required.

While unloading or transferring the fabricated panels from one location to another, prevent damage to the wrapping and the fabricated panel itself.

Any damage during offloading and transferring should be documented by the contractor unloading the material and the installer.

b. Geomembrane Storage

Leave the panels packaged in UV protected wrap until the day that the panels are to be in-stalled. If extremely hot or cold temperatures are present, keep the panels inside at a moderate temperature. This reduces the force required to unfold the panels.

Fabricated panels, when possible, should be stored on pallets off the ground. The storage area should be dry, level, and with a firm base to facilitate lifting; so the panels are not damaged, do not become dirty, and remain dry.

Part 3 – EXECUTION

3.01 Installation

a. Subgrade Preparation

A pre-installation inspection shall be requested by the geomembrane installer and ALL interested parties before moving panels from the storage location to the placement area. If the subgrade is deemed to be inappropriate for any reason, it should be remediated prior to geomembrane movement and placement.

Subgrade surfaces should be free of sticks, sharp objects, or debris that could puncture the interim cover. The surface should provide a smooth, flat, firm, un-yielding foundation for the geomembrane with no sudden, sharp or abrupt changes or break in grade that can tear or damage the geomembrane.

No standing water, mud, vegetation, snow, frozen subgrade, or excessive moisture is allowed before geomembrane placement. All pipes, vents, fitting, etc., which are to be installed beneath the geomembrane, should be in place, and ready to be covered with the geomembrane before panel deployment.

An anchor trench in the shape of a "U" or "V" can be used as a perimeter termination point for the geomembrane. Installation of the geomembrane shall be started from the anchor trench.

b. Unfolding and Deploying Prefabricated Panels

The geomembrane shall be supplied as a prefabricated panel with factory seams to reduce the amount of field seaming and testing.

An advantage of factory fabricated geomembranes is that manufactured rolls of material can be fabricated into large panels in a factory before shipment to the project site. This minimizes the amount of the field seaming and maximizes the amount of factory seaming which results in more high quality seams. The individual mill roll widths of the manufactured geomembrane rolls shall be assembled into large panels that are custom-designed for the specific project and correspond to the panel layout diagram. If factory seaming is maximized, field seaming can be reduced by 80 to 95 %. In other words, only 5 to 20% of all seams need to be made in the field depending on the unit weight of the geomembrane material. This reduction in field seaming improves seam quality, accelerates construction, minimizes or eliminates destructive field seam tests, reduces weather exposure issues, allows modular construction, and reduces project costs.

All large panels are accordion folded into a stack and rolled onto a heavy-duty 6" I.D. core then packaged in a separate outer wrap material. When the panels are unloaded on site, they should be positioned per the deployment instructions. Each panel should contain a deployment instruction sheet detailing how to roll out the panel to length and pull from the accordion folded stack to cover the width of the area. Confirm that the area to be covered is free of any materials that could damage the cover.

While unrolling and/or unfolding the geomembrane, inspect the fabricated panel for proper material type and thickness, damage, and/or defects. Repair any damage found.

Check weather conditions prior to starting installation and do not try to deploy covers in windy conditions. Site personnel should be spaced the length of the cover about every 15' to 30' depending on the weight of the panel being deployed. The site supervisor should coordinate the deployment of the cover material making sure the entire crew is pulling the cover material in equal proportions evenly across the entire length of the cover. Depending on the wind conditions, the crew should be able to take advantage of a slight breeze by pumping a layer of air under the cover material to help float the material while deploying. If at any time the air underneath becomes excessive, the deployment crew should pull the material closer to ground level to help push out some of the air. If a large wind gust comes up during deployment the crew should hold the material down to the ground temporarily until the wind gust passes.

Only material that is to be immediately welded or sewn, i.e., during that work-day, should be deployed. The deployment crew should ballast the leading edge at any point they stop to prevent wind damage. The material should be loosely laid out and never pulled tight or tensioned. Wrinkles or folds in the cover material should be worked throughout the overall area to prevent any stress points in the cover. Laying the material out loosely will allow for the expansion and contraction properties that are inherent to polyethylene. Normally, about 3% slack is recommended in each direction. Upon completion of the deployment process, the entire area should be inspected to insure that the 3% slack is evenly dispersed.

Once the cover has been completely inspected, the perimeter of the cover should be temporarily secured either with ballast or in an anchor trench. In most installations the cover is deployed and left out overnight, with weather conditions permitting, to assure the cover will not be shrinking any further due to cool weather after anchoring the perimeter. Once the cover has been determined to have sufficient slack, the cover can be anchored permanently. Attach to structure or placed into the trench and secure with backfill or other ballast materials.

Typically, sandbags are used as ballast and should be placed as required in the specifications per the actual site layout. However, new and cost effective ballast systems such as knitted reinforced geotextiles like Wind Defender, have been proven to be an effective longer term solution compared to ropes and sand bags.

If sandbags are chosen for ballast, they are normally spaced approximately 10' on center across the width direction and 5' on center the length direction. If used on perimeter, place bags end to end. When placing sandbags on slopes it may be advantageous to run a rope up the slope anchoring each sandbag accordingly. When material must be deployed on windy days it is suggested to pull out short sections and immediately place ballast on the material prior to moving on to the next sections.

When installing multiple panels, the additional panels should be deployed following the same procedures as listed above. The additional panels should be deployed and positioned to achieve the necessary overlap for seaming.

Once the geomembrane is properly placed, the material should be seamed as soon as practical.

c. Field Seaming

There are several methods that can be considered in joining pre-fabricated panels of Dura-Skrim® N30B, N30BT1 or K30B together in the field. Dura♦Skrim® N30B, N30BT1 or K30B interim covers protect from water intrusion and gas migration. For this reason, seaming the geomembranes is a vital factor in the installation process.

Before choosing a seaming method, consideration must be given to the application, outdoor conditions, longevity of the project, or the design engineer's recommendations for that particular application. Always review project drawings, specifications and QC requirements.

Reinforced Factory Fabricated Geomembrane Panels can be field seamed by the following methods:

- Field Thermal Seaming (automated hot wedge or hot air welding machine)
- Extrusion welding is allowed for detail work and repairs.

Seam Preparation

After the panels are initially placed in the proper position, remove as many wrinkles as practical. If possible, allow the panels to "relax" by allowing the panel to warm in the sun. The edges to be seamed need to be smooth and free of wrinkles to ensure good field seams and no "fish mouths."

An overlap of 0.15m (6 inches) for field thermal seaming must be cleaned of all dust, dirt, water, and foreign debris no more than 30 minutes prior to the heat seaming operation. Only clean, soft rags should be used for cleaning the areas to be seamed.

The seaming operation requires a solid, dry, smooth subsurface (see section 3.01 A. Subgrade Preparation). During the cleaning operation, the Dura♦Skrim® N30B, N30BT1 or K30B sheets will be inspected for proper type, thickness, and defective areas which must be removed and/or repaired prior to seaming.

d. Field Thermal Seaming (Solid Hot Wedge or Hot Air)

Field thermal seaming is performed with an automated hot wedge or hot air welding machine, which uses a heated element to melt the surfaces of the geomembranes to be welded and then presses the two sheets together to form a fusion bond. When performed properly, wedge welders and hot air welders produce high quality and consistent seams.

The wedge in a hot wedge welder can be heated with hot air (hot air method), or with electric resistance heating (hot wedge method). It is common to weld fabric supported material with a hot air wedge welder. All wedge welders employ a set point controller to accurately maintain the welding temperature within the most efficient welding temperature for the material. The pressure wheels are normally adjustable to allow for good material bonding after heating.

The single (or solid) wedge arrangement produces a fully bonded weld not less than 25 mm (1 inch) in width.

Seaming with a wedge welder is to be undertaken only by persons that have been trained and qualified in the use of the equipment (see section 2.01 B above). Repairs, maintenance, adjustments, and modifications are to be performed only by trained personnel.

Temperature controllers on the thermal welding device should be set according to type of geomembrane, thickness, ambient temperature, type of heating (air v. wedge), rate of seaming, and location of thermocouple within the device.

It is necessary for the operator to keep constant visual contact with the temperature controls, as well as the completed seam exiting the welder to ensure adequate welding is occurring. It is not recommended to adjust welding parameters without the approval of a trial seam (See section 3.01.D.1 below).

Pre-heating of the geomembrane in the seaming area is optional. The amount or type of pre- heating and its timing preceding the actual seaming is at the option of the installer.

Properly functioning portable electric generators must be available within close proximity of the seaming region and with adequate extension cords to complete the entire seam. These generators should be of sufficient size or number to handle all seaming electrical requirements. The generator must have rubber tires, or be placed on a smooth plate such that it is completely stable and it does not damage the geomembrane. Fuel (gasoline or diesel) for the generator must be stored away from the geomembrane, and if accidentally spilled on the geomembrane it must be removed immediately. The areas should be inspected for damage to the geomembrane and repaired if necessary.

e. Field Seaming Test Requirements

Test Seams (Trial Seams)

Welded test seams shall be prepared and tested by the Geomembrane Installer to verify that the seaming parameters are adequate at the start of each welding session or at the beginning of each working day.

Welded test seams also may be made whenever personnel or equipment are changed and when climatic conditions reflect wide changes in geomembrane temperature or other conditions that could affect seam quality.

Welded test seaming shall be conducted under ambient conditions and with the same equipment, geomembrane, and operator as field seaming on the fabricated panels. The welded test seams shall be at least 1.8 m (6 ft.) long for all types of field seams.

Each welded test seam shall be labeled with date, geomembrane temperature, weather conditions, number of seaming unit, panel identification, seam number or test location, technician performing the test seam, and a pass or fail description.

Non-Destructive Testing (NDT) of Seam Testing

All Field Seams shall be non-destructively tested by the Geomembrane Installer over the full length of the seams before the seams are covered. Each seam shall be numbered or otherwise designated. The location, date, test unit, name of the technician, name of QC person, and outcome of all NDT shall be recorded and submitted to the Owner's Representative.

Testing should be performed as the seaming progresses, not at the completion of all field seaming, unless agreed to in advance by the Owner's Representative. All defects found should be repaired, re-tested, and remarked to indicate acceptable completion of repair. NDT shall be performed using one or more of the following methods:

Air Lance Testing (ASTM D 4437) or FGI-4-2015: Guideline for Air Lance Testing of Field Geomembrane Seams

The Geomembrane Installer shall provide an air compressor, air hose, and air lance wand with a pressure gauge capable of measuring air flow to the tip. The testing shall be performed by experienced technicians familiar with this testing procedure.

This non-destructive test involves placing the air lance wand 6 to 12 mm (¼ to ½ inch), but not more than 50 mm (2 inches), from the edge of a completed seam and closely monitoring the backside of the sheet for any air penetration through the seam, loose edges, riffles, and/or noise. If air penetrates the seam area, the technician will either see this visibly or hear it audibly and the area shall be marked for repair.

Mechanical Point Stress or "Pick" test (ASTM D4437)

This NDT uses a dull tool (such as a blunt screwdriver) under the top edge of a field seam. With care, an installer can detect an un-bonded area, which is easier to separate than a properly bonded area. Care should be taken to not damage the already bonded areas. This method must be used with extreme care so as not to damage the parent thin gauge geomembrane and is to be used only if other NDT methods are not available.

Identification of Defects

Seams shall be inspected by the geomembrane installer and the owner's representative during and after field seaming to identify all dirty and wrinkled areas and any defects.

Evaluation of Defects

i. Each suspect location (both in geomembrane seam and non-seam areas) shall be non-destructively tested. Each location which fails non-destructive testing shall be marked, numbered, measured, and posted on the daily installation drawings and subsequently repaired.

ii. Defective seams, tears or holes shall be repaired by capping or cutting out the defective seam and re-seaming. Single seams in excess of 20% of their length requiring repair should be entirely removed and re-welded.

iii. Each patch or capping shall extend a minimum of 150 mm (6 inches) in all directions beyond the defect.

iv. All repairs shall be located, measured, non-destructively tested, and recorded.

f. Geomembrane Penetrations

All pipes, vents, fitting, etc., which are to be installed beneath the geomembrane, should be in place and ready to be covered with the geomembrane before geomembrane deployment. If possible, avoid cutting the geomembrane at details by using factory fabricated pipe boots that can be seamed to panels in the field. The following directions provide additional details for handling geomembrane penetrations:

i. Pipes

Whenever possible, avoid slitting geomembrane panels for piping details until a prefabricated or field fabricated pipe boot is ready for immediate installation. Cuts made in the geomembrane for clearance over penetrations should always be made as small as possible to minimize patch work.

Factory or field prepared pipe boots should fit snugly but not require excessive force to pull over a pipe. Pipe boot aprons should be seamed to the parent geomembrane using a hot air gun and a rubber covered hand roller.

The pipe boot sleeve should be attached to the pipe using butyl tape between the pipe and boot and two stainless steel band clamps.

ii. Concrete

Where bonding a geomembrane to concrete (or masonry) is required, the concrete surface should be smooth, clean, dry, and free of any sharp protrusions or rock in the backfill. Geomembrane to concrete seals shall be accomplished with mechanical anchors (e.g. fasteners, termination bars). An approved sealant is placed between the geomembrane and the concrete surface to ensure sealing.

g. Field Acceptance

The Geomembrane will be accepted by the Owner's Representative when all of the following have been completed:

1. The entire installation is finished or on agreed upon subsections of the installation are finished (3.01a through 3.01i).
2. All Installer's QC documentation is complete and submitted to the Owner.
3. Verification of the adequacy of all field seams and repairs and associated geomembrane testing is complete.

h. Site Clean Up and Demobilization

On completion of installation, the geomembrane cover installer shall dispose of all waste and scrap material in a location provided and approved by the owner. The installer should also remove all equipment used in connection with the work herein, and shall leave the premises in a neat and acceptable manner. No scrap material shall be left on the completed surface of the geomembrane or in the anchor trenches.

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