

This ClosureTurf® Specification document has been prepared to provide the Owner, Design Engineer, Construction Quality Assurance Professional of Record, and the Contractor / Installer with a general guidance specification. All information, recommendations and suggestions appearing in this specification concerning the use of our products are based upon experience, tests and data believed to be reliable; however, this information should not be used or relied upon for any specific application without independent professional examination and verification of its accuracy, suitability and applicability. The independent professional shall edit this document to suit the site specific project design criteria. Since the actual use by others is beyond our control, no guarantee or warranty of any kind, expressed or implied, is made by Watershed Geosynthetics LLC as to the effects of such use or the results to be obtained, nor does Watershed Geosynthetics LLC assume any liability in connection herewith. Any statement made herein may not be absolutely complete since additional information may be necessary or desirable when particular or exceptional conditions or circumstances exist or because of applicable laws or government regulations. ClosureTurf® product (US Patent No. 7,682,105, 8,585,322, 9,163,375 and 9,199, 287; Canadian Patent No. 2,663,170; and other Patents Pending) and trademark are the property of Watershed Geosynthetics LLC. Nothing herein is to be construed as permission to grant license or as a recommendation to infringe any patent.

SECTION 01 73 19

ClosureTurf® INSTALLATION

PART 1: GENERAL

1.01 SUMMARY

A. Section Includes:

Specifications for the Installation of the ClosureTurf® System.

B. Products Installed but not Furnished under this Section.

1. ClosureTurf® System.

- a. Include Sand Infill Component Installation.
- b. Include Alternate HydroBinder® Infill Installation.
- c. Include Alternate ArmorFill® Infill Installation

1.02 RELATED SECTIONS

Section 31 23 13 - Subgrade preparation (Upper 6 inches of subgrade only)

Section 01 42 00 - References and Definitions

Section 01 60 00 - ClosureTurf® Product Specification

Section 01 60 00 - ClosureTurf® MicroDrain® Product Specification

Section 01 60 01 - ClosureTurf® MicroSpike® Product Specification

- Section 01 73 19** - ClosureTurf® Installation Specification
- Section 31 05 16** - ClosureTurf® Sand Infill Specification
- Section 03 49 01** - Alternate HydroBinder® Infill Specification
- Section 23 51 23** - ClosureTurf® HDPE Pressure Relief Valve Specification

1.03 REFERENCES

- A. See Section 01 42 00 - References and Definitions

1.04 SUBMITTALS

A. MANUFACTURER:

- 1. Pre-Production Manufacturer's Quality Control (MQC) Data - Geomembrane Component:
 - a. Submit to the OWNER'S REPRESENTATIVE prior to ordering of geomembrane component.
- 1.) Certificate of Compliance that shows proposed material for this project will meet the project specifications.
- a.) Indicate tentative product order date and manufacturer location.
- 2.) Provide representative manufacturer Product Data sheets.
- 3.) Provide four (4) representative project product samples.
- 4.) Provide manufacturer's quality control program, including test procedures and frequencies for this product.
- 2. Pre-Shipment Manufacturer Quality Control (MQC) Data – Geomembrane Component:
 - a. Submit to the OWNER'S REPRESENTATIVE prior to shipment of geomembrane component:
 - 1.) A copy of the MQC results.

- 2.) Statement that MQC testing has been done in accordance with manufacturer's quality control program.
- 3.) Certificate of Compliance stating:
 - a.) Production dates and origin of resin.
 - b.) Reclaimed resin does not exceed 10 percent by weight.
 - c.) Any remaining MQC certifications required by the CONTRACT.
- 4.) MQC Certifications will include:
 - a.) Geomembrane roll numbers and identification;
 - b.) Sampling procedures; and
 - c.) Results of MQC tests, and the test methods used.

3. Conformance Testing - Geomembrane Component:

a. Sampling required at Manufacturer's Plant prior to shipment:

- 1.) OWNER'S REPRESENTATIVE will collect samples at the specified interval and sizes listed below:
 - a.) OWNER'S REPRESENTATIVE may also have a 3rd party collect the samples and have them shipped to an INDEPENDENT TESTING LABORATORY for testing.
 - 2.) Take samples across entire roll width.
 - 3.) Sample size: 15 inches x roll width.
 - a.) Indicate machine direction.
 - b.) indicate roll identification number.
 - c.) assign a unique conformance test number to the sample.
 - d.) mark sample with date listed above.
- 4.) Conformance samples:
- a.) Obtain for each resin lot; and
 - b.) Each 100,000 sq. ft. of geomembrane.

5.) Forward samples to the Independent Testing Lab for the following tests as they relate to Section 01 60 00 - ClosureTurf® PRODUCT SPECIFICATION – Article 2.03:

- a.) Density (ASTM D 792, Method B)
- b.) Carbon black content (ASTM D 4218)
- c.) Carbon black dispersion (ASTM D 5596)
- d.) Thickness (ASTM D 5994)
- e.) Tensile properties (ASTM D 6693/Type IV Specimen)

4. Limitations:

- a. No material will be delivered to the site until Independent Testing Lab results show conformance with the products specifications.
- b. The DESIGN ENGINEER will inform the INDEPENDENT TESTING LABORATORY in writing if additional test procedures are required.

5. MQC Testing – Engineered Turf Component:

- a. Provide inspection records of the tufting procedures for every 300,000 sq.ft. of Engineered Turf Include;
- b. Inspection records that indicate the following properties as they relate to Section 01 60 00 - ClosureTurf® Product Specification including;

1.) Tufting Gauge;

- 2.) Pile height;
- 3.) Roll length and roll numbers;
- 4.) Total product weight
- 5.) CBR Puncture ASTM D6241
- 6.) Tensile Strength Product (lbs./ft.) (MARV) ASTM D 4595
- 7.) Tensile Strength of Yarn (lbs.) (MARV) ASTM D 2256

6. Conformance Testing – Engineered Turf

- a. Obtain one Engineered Turf sample for every 400,000 sq. ft. of material supplied to the site.

b. Forward samples to the INDEPENDENT TESTING LABORATORY and test for the following:

- i. Total product weight
- ii. CBR Puncture ASTM D6241
- iii. Tensile Strength Product ASTM D 4595
- iv. Tensile Strength of Yarn ASTM D2256

B. GEOSYNTHETICS INSTALLER

1. Prior to beginning the installation of the ClosureTurf® System, GEOSYNTHETICS INSTALLER shall submit the following to the OWNER'S REPRESENTATIVE as it relates to the Geomembrane Component and the Engineered Turf component:

- a. The company will be an approved ClosureTurf Installer.
- b. Shop drawings indicating panel layout and field seams 14 calendar days prior to installation of geomembrane component.
- c. ClosureTurf® Installation schedule.
- d. Installation capabilities, including:

1.) Information on seaming, testing and deployment equipment proposed for this project;

2.) Average daily production anticipated for this project; and

3.) Construction Quality Control (CQC) procedures.

4.) Submit to OWNER'S REPRESENTATIVE:

a.) Signed Subgrade Acceptance Certificates for each area to be covered by the geomembrane component.

b.) A flow chart showing GEOSYNTHETICS PERSONNEL responsible positions for this project and include;

c.) Resumes of: (Include date hired and duration of employment)

- i. Project designated GEOSYNTHETICS SEAMING SUPERVISOR;

- ii. CQC SUPERVISOR if other than above;
 - iii. All personnel who will perform seaming operations; including;
 - iv. date hired and duration of employment.

- d.) Verify in writing that GEOSYNTHETICS INSTALLER'S PERSONNEL have the following experience:
 - i. CQC SUPERVISOR and the MASTER GEOMEMBRANE SEAMER:
 - i.) Shall have installed at least 5,000,000 square feet of like geosynthetics components.
 - ii. CQC SUPERVISOR and the ENGINEERED TURF FUSION SEAMER
 - ii.) Shall have installed at least 5,000,000 square feet of geomembrane materials.
 - iii.) Engineered Turf Fusion Seamers shall be factory trained by DemTech.
 - iii. GEOTEXTILE SEAMERS:
 - iv.) Shall have installed at least 1,000,000 square feet of like materials.
 - iv. All other GEOSYNTHETICS INSTALLER SEAMING PERSONNEL:
 - v.) Shall have seamed at least 1,000,000 s.f. of polyethylene geomembrane.
 - vi.) Personnel who have seamed less than 1,000,000 s.f. of polyethylene geomembrane will be allowed to seam only under the direct supervision of the MASTER GEOMEMBRANE SEAMER or CQC SUPERVISOR.

- e.) OWNER'S REPRESENTATIVE shall be responsible for approving resumes and qualifications of GEOSYNTHETICS INSTALLER PERSONNEL.

f.) GEOSYNTHETICS INSTALLER PERSONNEL shall attend ClosureTurf® orientation prior to the job beginning if this is their first ClosureTurf® installation.

C. SAND INFILL INSTALLER:

1. SAND INFILL INSTALLER shall submit to ClosureTurf® manufacturer a 10 pound sample of sand infill utilized.
2. SAND INFILL INSTALLER shall submit particle size data sheets approved by the POR for:
 - a. Sand infill used as a ClosureTurf® Component; and
 - b. Every 175 CY delivered thereafter.

1.) Sand Infill Testing Parameters:

See SECTION 31 05 16 ClosureTurf® SAND INFILL COMPONENT

D. CLOSEOUT SUBMITTALS:

1. GEOSYNTHETICS INSTALLER shall furnish to the OWNER upon completion of the project:
 - a. 1-year warranty against defects in workmanship.
 - b. As-built Geomembrane Panel Drawings.
 - c. As-built Drawings will include:
 - d. panel locations;
 - e. panel identification numbers;
 - f. geomembrane roll numbers for each panel;
 - g. seam caps;
 - h. destructive sample locations; and
 - i. location of large repairs.
 - j. Any other documentation required under Section 01 73 19 – G

E. PRODUCT DATA

1. See Section 01 60 00 PRODUCT SPECIFICATION – Article 2.03

F. CERTIFICATES

- 1. Placeholder to include premade certificates Contractors are expected to complete and have approved as a condition of progressing with Work.**

G. RECORD DOCUMENTATION

- 1. Placeholder to include Requirements for Record Documentation specific to the project, state, or federal regulations here.**

2. The POR, on behalf of the OWNER, will submit to the governing regulatory agencies a FCSER (Final Cover System Evaluation Report) for record of the final cover system constructed.
3. Testing, evaluation, and submission of the FCSER for the final cover system during construction will be in accordance with this CQA Plan.
4. The construction methods and test procedures documented in the FCSER will be consistent with this CQA Plan.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Conform to the manufacturer's recommendations to prevent damage.
- B. Deliver materials to the site only after the OWNER'S REPRESENTATIVE and the OWNER approve required submittals.
 1. CQA PERSONNEL shall observe and document that all rolls of geomembrane delivered to the site have been properly identified (at the manufacturer's location) with the following for each component:
 - a. Delivery and Acceptance Requirements –Geomembrane Component:

- 1.) Manufacturer's name
 - 2.) Product identification
 - 3.) Lot number
 - 4.) Roll number
 - 5.) Roll dimensions
- b. Delivery and Acceptance Requirements –Engineered Turf Component:
- 1.) Manufacturer's name
 - 2.) Product identification
 - 3.) Lot number
 - 4.) Roll number
 - 5.) Roll dimensions
2. CQA PERSONNEL shall observe and document the following with regard to each component:
- a. Engineered Turf is wrapped in rolls with protective covering;
 - b. Components are protected from any outside source that could degrade or damage the product.
- A. Storage and Handling Requirements:
1. On-Site Storage
 - a. Store in space allocated by the OWNER.
 - b. Store on level prepared surface (not on wooden pallets) graded to drain away from ClosureTurf® components.
 - c. Stack per Manufacturer's recommendation but no more than three rolls high.
 2. On-Site Handling:
 - a. The GEOSYNTHETICS INSTALLER is responsible for storage and transporting material from storage area to installation area
 - b. Use appropriate handling equipment approved by the OWNER'S

REPRESENTATIVE.

- c. Dragging panels on ground surface will not be permitted.
- d. Do not fold geomembrane component material;

3. Packaging and Waste Management

- a. GEOSYNTHETICS INSTALLER shall be responsible for proper containment, collection and disposal of:
 - 1.) Waste and packaging;
 - 2.) All waste products produced by the installation of the ClosureTurf[®] System.

1.06 SITE CONDITIONS

A. Ambient Conditions

- 1. In excessive heat or cold, ambient temperatures less than 35°F and greater than 104°F will require additional testing as indicated below.
- 2. The acceptable ambient temperature range may vary from parameters shown in Article 1.06A-1 only if field test seams can pass at the specific ambient temperature welding will take place.

B. Existing Conditions

- 1. See Section 31 23 13 for Subgrade Preparation Specifications

1.07 WARRANTY

A. Coordination: See Section 00 72 00 – General Conditions and 01 78 36 – Warranties

PART 2: PRODUCTS

2.01 OWNER FURNISHED PRODUCTS

- A. Fabricated and Geosynthetic components of the ClosureTurf[®] System.

1. Geomembrane Component.
 - a. Manufacturer: AGRU America, Inc.
 2. Engineered Turf Component.
 - a. Shaw Industries, Inc.
- B. Gas Vents.
- a. Watershed Geosynthetics, Inc.

C. SUBSTITUTIONS

- a. None

2.02 PRODUCTS NOT FURNISHED BY OWNER

- A. Sand Infill Component. (Section 31 05 16)
- B. Alternate HydroBinder[®] Infill Component. (See Section 03 49 01)

2.03 EQUIPMENT

- A. GEOSYNTHETICS INSTALLER shall demonstrate that welding equipment and accessories meet the following requirements:
1. Wedge welding machines are a low profile machine with a vertical height (wedge height) not to exceed 3 inches, measured from flat surface to top of heating wedge.
 2. Welding machines are equipped with gauges showing temperatures both in apparatus and at nozzle (extrusion welder) or at wedge (fusion welder).
 3. Adequate numbers of welding apparatus are maintained to avoid delaying work.
 4. Use power source generators capable of providing constant voltage to all required equipment under combined-line load.

5. Provide secondary containment to catch spilled fuel under equipment where applicable.
- B. Provide calibrated tensiometer capable of quantitatively measuring geomembrane component strength for the following parameters:
- a. Tensiometer to be equipped with gauge accurate to +/- 2 lbs per inch of geomembrane width; and
 - b. capable of pulling at 2 inches per minute up to 20 inches per minute.
- C. Provide one inch die for cutting sample specimens.
- D. Provide certificate of tensiometer calibration within the past 12-months.

2.04 PRODUCT OPTIONS

- A. Infill Component Option will be noted on the DRAWINGS:
1. Sand Infill. See Specification 31 05 16 – Sand Infill Specifications; or
 2. HydroBinder® Infill. 03 49 01 – Alternate HydroBinder® Infill.

2.05 MANUFACTURER QUALITY CONTROL (MQC)

- A. Tests and Inspections
1. See Section 01 73 19 - 1.04 SUBMITTALS for MQC requirements.
 2. See Section 01 73 19 - 3.02 FIELD TRIAL SEAM TESTING for field testing requirements.

2.06 CONSTRUCTION QUALITY CONTROL

- A. GEOSYNTHETICS INSTALLER shall:
1. Designate a full-time construction quality control (CQC) SUPERVISOR; who
 2. Shall be responsible for supervising and/or conducting the construction

quality control program; and

3. May not be replaced without written authorization by the OWNER.

4. Meets resume requirements Section 01 73 19 – 1.04 B

PART 3: EXECUTION:

3.01 INSTALLERS

A. Must be approved through Watershed Geosynthetics, LLC.

3.02 EXAMINATION

A. VERIFICATION OF CONDITIONS:

1. OWNER'S REPRESENTATIVE:

a. Verify provisions set forth in Section 31 23 13 – SUBGRADE PREPARATION.

b. Verify SUBMITTALS and forms have been completed.

B. PRE-INSTALLATION TESTING

1. FIELD TRIAL SEAM TESTING – TRIAL WELDS: GEOMEMBRANE

a. Prior to geomembrane component welding, CQA personnel shall observe and document the following:

1.) Welding apparatus (both wedge and extrusion welder) are tested;

a.) at daily start-up; and

b.) immediately after any break; or

c.) anytime the machine is turned off for more than 30 minutes.

b. Procedures:

1.) If at any time, the CQA PERSONNEL believe that an operator or welding apparatus is not functioning properly, a Field Trial Seam Test must be performed.

- 2.) Any dispute concerning proper installation techniques or the proper function of welding equipment shall be resolved by the OWNER'S REPRESENTATIVE.
- 3.) The trial weld must be allowed to cool to ambient temperature before testing.
 - a.) Trial Sample Test Results:
- 4.) Trial weld samples must comply with "PASSING CRITERIA FOR WELDS" included in Section 3.13.
- 5.) Field Seam Test Failure:
 - a.) Unacceptable locus-of-break codes per their description in ASTM D6392:
 - i. Hot Wedge: AD and AD-Brk > 25%
 - ii. Extrusion Fillet: AD1, AD2, AD-WLD (unless strength is achieved)
 - b.) There will be no apparent weld separation (i.e., greater than 25% of weld width)
 - c.) The INDEPENDENT TESTING LABORATORY strength tests must:
 - i. meet the manufacturer's specifications for the sample sheets; or
 - ii. percentage of the manufacturer's parent sheet strength as determined by the manufacturer.
 - iii. For dual-track fusion welds, both sides (the inner and outer weld) must meet the minimum requirements for a satisfactory peel test.
 - c. Additional Field Seam Testing Requirements - GEOMEMBRANE
 - 1.) A trial weld will also be obtained prior to welding tie-ins.
 - 2.) The trial weld sample must be 3 feet long and 12 inches wide, with the seam centered lengthwise.
 - 3.) If a welding apparatus exceeds 5 hours in the second half of the day, another trial seam must be performed.
 - 4.) Minimum required number of specimens per trial weld:
 - i. Two coupons for shear and two coupons for peel.

- ii. Both the inner and outer welds of dual track fusion welds:
 - vii.) must be tested for each peel test coupon; or
 - viii.) additional coupons will be required.
- d. CQA documentation of trial seam procedures will include the following:
 - 1.) The names of the seaming personnel;
 - 2.) The name of the welding technician;
 - 3.) the welding apparatus number, time, date;
 - 4.) ambient air temperature; and
 - 5.) welding apparatus temperature.

2. FUSION SEAMING METHOD TRIAL SEAM REQUIREMENTS – ENGINEERED TURF

- a. Prior to turf component welding, CQA personnel shall observe and document the following:
 - 1.) Turf welding apparatus are tested;
 - 2.) at daily start-up; and
 - 3.) immediately after any break; or
 - 4.) anytime the machine is turned off for more than 30 minutes.
- b. Procedures:
 - 1.) If at any time, the CQA Personnel believe that an operator or fusion welding apparatus is not functioning properly, a Field Trial Seam Test must be performed.
 - 2.) Any dispute concerning proper installation techniques or the proper function of fusion welding equipment will be resolved by the OWNER’S REPRESENTATIVE.

- c. The trial weld must be allowed to cool to ambient temperature before seam snapping or panel adjustments are applied.

1.) Trial Sample Test Results:

- i. Trial weld samples must comply with “VISUAL PASSING CRITERIA” Visual passing criteria is verified when a manual peel/pull test is performed, and the top turf panel tufts transfer to the bottom turf panel. The transfer of approx. 75% of the tufts constitutes a passing trial weld.

2.) Field Seam Test Failure:

- i. Less than approx.75% of the top turf panel tufts transfer to the bottom turf panel.

3.) Additional Trial Sample Testing Requirements:

- i. Two consecutive trial welds meet the visual passing criteria.

4.) The trial weld sample must be a minimum of 3 feet long and 12 inches wide, with the seam centered lengthwise.

5.) If a welding apparatus exceeds 5 hours in the second half of the day, another trial seam must be performed.

6.) CQA documentation of trial seam procedures will include the following:

- ii. The names of the seaming personnel;
- iii. The name of the fusion seaming technician;
- iv. the welding apparatus number, time, date;
- v. ambient air temperature; and
- vi. welding apparatus temperature.

3.03 INSTALLATION

A. ClosureTurf® GEOMEMBRANE COMPONENT DEPLOYMENT

1. Geomembrane Component will not be deployed:
 - a. During precipitation;
 - b. In the presence of excessive moisture as determined by the CQA Personnel onsite;
 - c. In areas of ponded water;
 - d. In the presence of excessive winds (sustained winds greater than 25 MPH) or at the discretion of the POR.

2. CQA PERSONNEL shall observe the following while the geomembrane component is being deployed:
 - a. Use equipment which will not damage geomembrane.
 - b. Observe that personnel working on geomembrane do not engage in activities that could damage ClosureTurf[®] Components.
 - c. Smoking on the liner is prohibited.
 - d. Clamps and other metal tools are not tossed or thrown.
 - e. Geomembrane component has had adequate time to acclimate to ambient temperature prior to welding.
 - f. Panels are deployed with the spike down and the stud side up.
 - g. The deployment method will protect both the geomembrane component as well as the underlying subgrade.
 - h. Adequate anchoring techniques are placed to prevent uplift by wind.
 - i. Anchoring techniques are used that will not damage the geomembrane component.
 - j. Continuous sand bags are used along leading edges of the geomembrane to reduce wind flow under panels.
 - k. Panels will be deployed perpendicular to slope elevation contours.
 - l. Generation of seams will be reduced where possible.
 - m. Protect geomembrane in heavy traffic areas using methods approved by the POR.
 - n. Rubber tired ATV's are acceptable if specified wheel pressure limitation is

specifically observed and provided to the POR by the GEOSYNTHETICS INSTALLER in writing.

- o. The bottom and side anchor trenches are left open until the engineered turf and sand infill placement are complete.
- p. Top anchor trenches are backfilled as soon as practical to avoid creeping of the geomembrane.
- q. Verify that the ClosureTurf[®] system is properly deployed into the anchor trench prior to backfilling.
- r. Where possible, anchor trenches are filled when temperatures are coolest to reduce bridging of the geomembrane component.
- s. Material placed in anchor trenches are placed in uniform lifts, not to exceed 12 inches loose thickness and are compacted.
- t. In-place moisture/density tests in anchor trenches may be taken at the discretion of the POR.
- u. Slightly rounded corners will be provided in anchor trenches.

3.04 WRINKLES

A. The CQA PERSONNEL shall:

1. Inspect geomembrane for wrinkles; and
2. Notify the GEOSYNTHETICS INSTALLER if wrinkles are present above the maximum tolerance level as described below.
3. Document corrective actions taken to reduce the wrinkles.
4. Observe that wrinkles are reduced prior to field seaming.
5. Observe that snapping procedures described in Article 3.06 SPECIAL TECHNIQUES are followed.

B. Any wrinkles that can fold over must be repaired if:

1. Overnight temperature reduction does not contract the geomembrane to an

acceptable level as determined by the CQA PERSONNEL.

- C. Time constraints do not allow for an overnight wait time to observe whether wrinkles were reduced adequately.

3.05 ClosureTurf® GEOMEMBRANE COMPONENT FIELD SEAMING

A. CQA PERSONNEL must observe the following:

1. Prior to geomembrane seaming operations:
 - a. Panel layout drawing has been accepted by the POR.
 - b. A seam numbering system has been incorporated agreed upon by the POR and GEOSYNTHETICS INSTALLER prior to the start of seaming operations.
 - c. The GEOSYNTHETICS INSTALLER shall have a previously agreed upon number of welding apparatus and spare parts necessary to perform the work.
 - d. Verify that equipment used for welding will not damage any ClosureTurf® system components.
 - e. The extrusion welding machine is purged to remove heat degraded extrudate.
 - f. Seam grinding has been completed less than one hour before seam welding; and
 - g. The upper sheet is beveled (extrusion welding only).
 - h. The ambient temperature requirements (Section 1.06 SITE CONDITIONS), are met.
 - i. The contact surfaces of the sheets are clean, free of dust, grease, dirt, debris, and moisture prior to welding.
 - j. The weld area is substantially free of dust, rocks, and other debris.
 - k. The seams are overlapped a minimum of 3 inches for extrusion and hot wedge welding, or in accordance with manufacturer's recommendations, whichever is more stringent.
 - l. Panels will be overlapped (shingled) in the downgrade direction.

- m. No solvents or adhesives are present in the seam area.
- n. The procedure used to temporarily hold the panels together does not damage the panels and does not preclude CQA testing.
- o. The panels to be welded are in accordance with the plans and site specific specifications.
- p. There is no obvious free moisture in the weld area.
- q. Measure and document surface sheet temperature every two hours.
- r. At the end of each day or installation segment, unseamed edges are anchored with sandbags or other approved anchoring device.

2. During Geomembrane Seaming Operations:

- a. At the end of previously placed welds, (with a cooling time longer than 5 minutes), grinding is required to expose new material before restarting a weld (extrusion welding only).

3.06 SPECIAL TECHNIQUES

A. During field seaming operations special attention will be taken for the following:

1. GEOMEMBRANE COMPONENT:

- a. Once two panels have been seamed together or at the approx. 1/3 seaming process, a seam snapping process should be applied.

- 1.) Perform with manual labor by utilizing 3-4 technicians on the open side of the panel applying a pulling pressure to snap out the tented welded seam.

2. ENGINEERED TURF COMPONENT:

- a. CQA PERSONNEL shall verify that:

2.) Engineered Turf tufts are not excessively pulled out by the installation process.

3.) See Section 01 73 19 – Article 3.07 for further information.

3.07 ENGINEERED TURF COMPONENT DEPLOYMENT

- A. Prior to installation of Engineered Turf Component, the CQA PERSONNEL must observe the following:
1. ClosureTurf[®] geomembrane component has been seamed, tested, approved, and is released for further component deployment by the POR.
 2. The supporting surface (e.g., the geomembrane) is substantially free of debris or large scraps.
- B. During deployment of Engineered Turf, the CQA personnel must observe the following:
1. Observe the turf as it is deployed and record defects and disposition of the defects (i.e., panel rejected, patch installed, etc.).
 2. That repairs are made in accordance with the specifications.
 3. Equipment used does not damage the turf or underlying geomembrane.
 4. That all panels are deployed from the top of the slope in a way that the Engineered Turf filaments are pointing upslope after deployment is complete.
 5. That the turf is anchored to prevent movement by the wind (the GEOSYNTHETICS INSTALLER is responsible for any damage resulting to or from windblown Engineered Turf).
 6. That the turf remains substantially free of contaminants.
 7. That the turf is laid substantially smooth.
 8. That on slopes, the turf is secured with sandbag anchoring at the top of the slope after deployment.
 9. That the first panel deployed has the turf filaments facing upward.

10. That subsequent panels are deployed turf side down, and on top of the previous panel. (Sewing Method Only)
11. That after seaming each panel, it is flipped onto the geomembrane component with care to avoid pulling of tufts in the drainage studs. (Sewing Method Only)
12. A single stitch prayer type seam is constructed using a Newlong sewing machine or equivalent. (Sewing Method Only)
13. The thread will be 207 Polyester or equivalent.
14. Sewing will occur between the 1st and 2nd row of tufts on both sides of panel.

3.08 ENGINEERED TURF COMPONENT FUSION SEAMING METHOD:

A. Techniques for Fusion Seaming Engineered Turf will be as follows:

1. Engineered Turf fusion seaming device will be a DemTech VM20/4/A fusion welder only.
2. Fusion seams require a minimum of 5 inches of overlap.
3. Frayed or loose geotextile strands will be cut off or removed.
4. Prior to starting the production fusion seaming, trial seams must be performed as outlined in Section 3.02.
5. Demonstrate the preparation methods and equipment utilized for removal of the selvage from the outside edge of the rolls of turf (i.e. trimming & cutting devices).
6. Mechanical or hot knife trimming and cutting devices will be utilized for salvage trimming.
7. Demonstrate and control the fraying of geotextile strands when performing the

removal of selvage.

8. Any damage that occurs due to production seaming will be repaired as outlined in WG Installation Guidance Documents.
9. Any defects will be repaired as outlined in Section 3.14.

3.09 EQUIPMENT ON THE TURF:

A. During Construction:

1. On slopes exceeding 15%:
 - a. No equipment will be allowed until Sand Infill is in place.
2. On slopes less than 15%:
 - a. ATV type vehicles will be allowed prior to infill placement if the tire /track ground contact pressure is less than 5 psi.

B. Post construction (full specified sand infill thickness)

1. On slopes exceeding 15%
 - a. Temporary or transient loads, allowable tire/track ground contact pressures will be limited to less than 35 psi
 - b. Regularly trafficked areas will be designed and approved by the POR and/or CQA Engineer
2. On slopes less than 15%:
 - a. Temporary or transient loads, allowable tire/track ground contact pressures will be limited to less than 85 psi
 - b. Regularly trafficked areas will be designed and approved by the POR
 - c. Allowable tire/track ground contact pressures may be increased with the written approval of the POR and/or CQA Engineer.

- C. Any activity that may be identified during the course of construction by the POR, OWNER'S REPRESENTATIVE, or CQA PERSONNEL as being a possible danger to the integrity of the ClosureTurf® system will be prohibited regardless of any prior approval.

Note to Author: The above suggested equipment load limits are based on assumptions that: (1) the subgrade is firm and unyielding and able to support the equipment without creating rutting or bearing capacity issues; and (2) the subgrade is free of sharp rock fragments or stones, large stones and other deleterious matter such as tree roots, construction debris and metallic objects that could cause damage to ClosureTurf. The CQA Engineer should verify the subgrade conditions and approve the suggested equipment load limit.

3.10 SAND BALLAST INFILL PLACEMENT

- A. Sand infill that is placed between the tufts of the Engineered Turf Component:
 - 1. The sand infill layer will be placed to a ½ inch minimum thickness not to exceed ¾ inch thick.
 - 2. Will consist wholly of sand meeting Section 31 05 16, ClosureTurf® SAND INFILL COMPONENT.
 - 3. CQA PERSONNEL shall check final thickness of sand infill at a rate of approximately 20 times per acre.
- B. ClosureTurf® Sand Infill Grain Size Parameters are shown in Section 31 05 16 – Table 1.
 - 1. CQA PERSONNEL shall observe that the following requirements regarding Sand Infill are met:
 - a. Installation of sand infill will only be performed by a Watershed Geosynthetics' licensed and approved installer.
 - b. Areas that are to receive sand infill must be accepted by the POR or CQA PERSONNEL before placement of sand infill takes place.
- C. CQA PERSONNEL shall observe:
 - 1. The sand infill is worked into the Engineered Turf between the synthetic yarn

blades.

2. Conveyor systems and/or Express Blowers will be used to spread and place the sand infill.
3. Sand Infill Installer has explained with detail in the pre-construction meeting the method of sand infill deployment to be used.
4. That previously installed ClosureTurf® components are not displaced or damaged as a result of the sand infill component installation.
5. That Sand infill placement does not occur with snow or ice on the Engineered Turf component.
6. The method for measuring the Sand Infill thickness will be performed utilizing a digital caliper, or a POR approved alternate measuring device.

3.11 ALTERNATE INFILL – HYDROBINDER® PLACEMENT

- A. See Section 03 49 01 ALTERNATE HydroBinder® INFILL for Product Specification
- B. The HydroBinder® infill layer may be placed using any appropriate equipment capable of completing the work.
 1. Manual hand spreading is acceptable when equipment isn't practical.
- C. CQA PERSONNEL shall verify the following:
 2. GEOSYNTHETICS INSTALLER shall explain in detail in the pre-construction meeting the method of HydroBinder® infill deployment.
 3. Installation of HydroBinder® infill will only be performed by a Watershed Geosynthetics' licensed and approved installer.
 4. Additional information concerning various Installation Techniques can be found in the ClosureTurf® Installation Guidelines Manual.
 5. The HydroBinder® will be installed into the turf while it is in a dry state.

6. The HydroBinder[®] will be worked into the tufts so the tufts are in an upright position.
7. The HydroBinder[®] infill layer will be placed to a $\frac{3}{4}$ inch minimum thickness not to exceed 1 inch thick.
8. Multiple passes will be required so the tufts can be more readily freed from the weight of the HydroBinder[®] on each pass before hydration takes place.
9. Engineered Turf Tufts will be free and upright before the hydration process begins.
10. HydroBinder[®] thickness will be checked using a caliper or other approved measuring device.
 - a. Take thickness measurements of the dry HydroBinder at a rate of 20 samples per acre.
 - b. The desired HydroBinder[®] infill thickness will be achieved prior to the hydration process.
11. Do not backfill horizontal or vertical anchor trenches until turf has been infilled with HydroBinder[®] infill.
12. The hydration process must occur the same day as the HydroBinder[®] infill placement.
 - c. Check to assure HydroBinder[®] is hydrated thoroughly through the full thickness, without causing excessive runoff using the following methods:
 - 1.) Check each completed hydration area for full saturation using a probe before moving on the next area.
 - 2.) Check hydration with probe at a rate of 1 per 100 sq. ft..
 - 3.) Check for full hydration by tapping on hydrated surface forcing water to be visually seen pooling at the surface.
 - d. The estimated application rate is 0.20 gallons of water per sq. ft.

1.) Rate may change according to ambient temperature and humidity.

e. After 24 hrs.;

1.) Check completed HydroBinder to ensure the hardening process is taking place.

a.) Note that the dustless version of HydroBinder® may take longer than 24 hrs to reach an obvious hardness to the touch.

f. The 28 day compression strength of the HydroBinder® is verified by the manufacturer of the HydroBinder® before the mix is delivered to the site.

D. Cold Weather Placement and Curing of HydroBinder®. Follow Procedure shown in American Concrete Institute (ACI) 306 – Guide to Cold Weather Concreting.

1. At the time of HydroBinder placement;

a. both the subgrade and the surface of the Engineered Turf will be at a temperature of at least 36 degrees.

b. Ambient temp will be rising.

3.12 ALTERNATE INFILL – ARMORFILL® EMULSION

A. See also Section 31-32-13.17 -ArmorFill® -Polymer Emulsion Specification

B. INSTALLERS

1. Installation of ArmorFill® will be completed by an installer approved by Watershed Geosynthetics.

C. EXAMINATION

1. ArmorFill® should be shipped to site within one (1) month of anticipated use.

2. Apply ArmorFill® under dry weather conditions and when precipitation is not expected for at least 72 hours after installation.

3. ArmorFill® cure time is dependent on ambient temperature, humidity and any rainfall that may occur while product is curing.

4. Apply ArmorFill® on a previously installed ClosureTurf® system that is free of

leaves and other material that may inhibit the penetration of the ArmorFill® into the sand component.

5. Apply ArmorFill® only after approval of the finished ClosureTurf® product installation.
6. Construction Quality Control (CQC) personnel will document ArmorFill® and water mix ratio by logging volume mixed of each component.
7. Construction Quality Control (CQC) personnel will verify that ArmorFill® has fully saturated the sand by inserting a probe and displacing a 1 sq. inch area of sand.
 - a. Check saturation randomly at a rate of 20 probes per acre.
8. Verify proper application rate by marking a known area and applying the proper volume to that area.
 - a. Adjust delivery rate to match the delivery volume per area.

D. SPECIAL TECHNIQUES

1. Mix in a hydraulic conveyance system such as a water truck, HydroSeeder or portable tank.
 - a. Place the water component in the tank, then add the full strength ArmorFill® .
 - b. Mechanically agitate initially, and each day prior to use.
 - c. Do not utilize continuous agitation techniques that may introduce excess air into the system.
2. ArmorFill® application equipment will have a hose with a spray adjustment nozzle and cut off function in the nozzle head.
3. Reduce the number of equipment set-ups required and take care with the application hose so as previously applied ArmorFill® is not displaced by dragging of the hose.
4. Spray product evenly.
5. Apply marking features to edge of sprayed area to assure proper overlap of material.
6. Each stopping point will require visual marking locations to assure the continued application has the proper overlap.

7. Deploy catch cups at a rate of 20 per acre to help determine if proper application rate is being achieved.
8. Apply ArmorFill® at a rate of approximately 3400 gallons of the mixed product per acre (Approx. 90 ounces per square yard)
9. Do not apply ArmorFill® in inclement weather or in freezing temperatures.
10. One Thousand Six Hundred Fifty (1650) gallons of water per Two Hundred Seventy Five (275) gallon ArmorFill® tote is the proper mixture for a 6:1 ratio.

E. CLOSE OUT ACTIVITIES

1. At the completion of ArmorFill® placement activities, clean the equipment thoroughly and purge the tank and hoses of the product.
2. All waste product will be disposed of in accordance to site regulations and specifications.
3. Left over mixed product may be evenly sprayed over previously applied ArmorFill® areas.
4. Avoid unnecessary foot traffic on the applied product for 48 hours.
5. No vehicle traffic is allowed on the applied product for 7 calendar days.

3.13 TESTING CONCURRENT WITH INSTALLATION:

A. DESTRUCTIVE AND NON-DESTRUCTIVE TESTING:

1. NON-DESTRUCTIVE SEAM TESTING – Geomembrane Component:

a. GEOSYNTHETICS INSTALLER shall:

- 1.) non-destructively test field welds for continuity over their full length using vacuum, air pressure or spark test units; and
 - a.) Perform concurrently with seaming work progress.
 - b.) Repair seam defects in accordance with Article 3.14 REPAIR PROCEDURES.

2.) Non-destructive testing procedures:

- a.) apparatus used to test the field seams for continuity:

- i. Vacuum box testing equipment for extrusion welds will have:
 - ii. A rigid housing;
 - iii. transparent viewing window;
 - iv. a soft rubber gasket attached to bottom of housing; and
 - v. porthole or valve assembly; and
 - vi. a vacuum gauge.
 - vii. be capable of applying 2 psi gage pressure of vacuum to the box.
 - viii. Soapy solution.

b.) Vacuum Box testing procedures:

- i. Clean window, gasket surfaces, and check for leaks.
- ii. Energize vacuum pump and reduce tank pressure to approximately 2 psi.
- iii. Wet a strip of geomembrane approximately 12 inches by 30 inches (or length of box) with soapy solution.
- iv. Place box over wetted area and compress.
- v. Close bleed valve and open vacuum valve.
- vi. Ensure that a leak tight seal is created.
- vii. Examine length of weld through viewing window for presence of soap bubbles for a period of not less than 10 seconds.
- viii. If no bubbles appear after 10 seconds, close vacuum valve and open bleed valve, move box over next adjoining area with minimum three inches overlap and repeat process.

c.) Defects:

- i. Mark with a defect code;
- ii. repair the area in accordance with Section 01 73 19 Article 3.14 REPAIR PROCEDURES; and

iii. retest the repaired area.

d.) Air Pressure Testing equipment for double fusion seams:

- i. An air pump, equipped with pressure gauge having an accuracy of 1 psi, capable of generating and sustaining a pressure between 25 to 30 psi and mounted on a cushion.
- ii. Rubber hose with fittings and connections.
- iii. Sharp hollow needle or other pressure feed device approved by the Owner.

e.) Air Pressure testing procedures:

- i. Seal both ends of the seam to be tested.
- ii. Insert a needle or other approved pressure feed device into tunnel created by double hot wedge seaming and insert a protective cushion between air pump and geomembrane.
- iii. Energize air pump to 25 to 30 psi, close valve, and sustain pressure for a minimum of five minutes.
- iv. If loss of pressure exceeds 2 psi or does not stabilize, locate faulty area and repair in accordance with Article 3.14 REPAIR PROCEDURES.
- v. Release pressure at opposite end of seam from gauge to verify that the seam is not blocked.
- vi. Remove approved pressure feed device and seal penetration holes by extrusion welding.

b. DESTRUCTIVE SEAM TESTING Geomembrane Component:

a. GEOSYNTHETICS INSTALLER shall:

- 1.) cut destructive samples 12 inches wide by 48 inches long with seam centered lengthwise.

- 2.) Repair holes in geomembrane resulting from obtaining destructive samples and vacuum test patches.
- 3.) Obtain two 1-inch wide specimens from each side of the sample, test for peel and shear in the field.

- i. Provide OWNER'S REPRESENTATIVE with the following:

- (i) one sample per 500 feet of seam length per welding apparatus prior to completion of liner installation;

- b. OWNER'S REPRESENTATIVE shall:

- 1.) mark destructive samples with:

- a.) consecutive numbering;
 - b.) location;
 - c.) apparatus I.D.;
 - d.) technician I.D.;
 - e.) Engineer I.D.;
 - f.) apparatus settings; and
 - g.) date;

- 2.) record, in written form:

- a.) weld and test date;
 - b.) time;
 - c.) location;
 - d.) seam number;
 - e.) ambient temperatures;
 - f.) machine settings;
 - g.) technician I.D.;
 - h.) apparatus I.D.; and
 - i.) pass or fail description.

- c. Additional Destructive Testing Procedures:

- 1.) Cut ten 1-inch wide specimens from one piece.
- 2.) Test five specimens for peel and five for shear.
- 3.) Test results will meet requirements of Section 01 73 19 -
INSTALLATION OF ClosureTurf® - Article 3.13.B – PASSING
CRITERIA FOR WELDS.

4.) Failing Destructive Tests:

a.) GEOSYNTHETICS INSTALLER'S CQC
REPRESENTATIVE shall;

a.) track the failure immediately.

b.) Cut the remaining sample into three 14-inch long pieces and distribute as follows:

- i. To the Owner's Representative for destructive testing;
and
- ii. To the Owner's Representative for archive; and
- iii. To the Geosynthetics Installer for their use.

c.) In the event of failure, the procedures for failed seam tracking are:

- i. Retrace welding path 10 (ten) feet in both directions
from the failed test location and remove (at these
locations) a one inch wide specimen for testing.
- ii. Obtain destructive samples from each side of the welding path and give samples to
the OWNER'S REPRESENTATIVE for destructive testing.
- iii. Repeat process if additional tests fail.
- iv. Reconstruct seam between passing test locations to satisfaction of the OWNER'S
REPRESENTATIVE.
- v. Reconstruction may be one of the following:
 - (ii) Cut out old seam, reposition panel and re-seam.
 - (iii) Add cap strip.
 - (iv) Cut additional destructive samples from
reconstruction at discretion of OWNER'S
REPRESENTATIVE.

- (v) If additional destructive sample results are not acceptable, repeat process until reconstructed seam is judged satisfactory by the OWNER'S REPRESENTATIVE.

5.) Final seaming inspection:

a.) check the seams and surface of geomembrane for:

- i. Defects;
- ii. Holes;
- iii. Blisters;
- iv. Undispersed raw materials; or
- v. Signs of contamination by foreign matter.

b.) Brush, blow, or wash geomembrane surface if dirt inhibits observation.

c.) The OWNER'S REPRESENTATIVE shall decide if cleaning of geomembrane surface and welds is needed to facilitate inspection.

B. PASSING CRITERIA FOR WELDS

1. Passing criteria are established by Geosynthetic Institute Test Method GM-19 for geomembrane seams.

a. An extrusion or fusion-welded seam will pass when the following values are met:

- 1.) Shear and peel strengths are for 4 out of 5 test specimens (the 5th specimen can be as low as 80 percent of the listed values)
- 2.) Shear strength (lb./in) 100
- 3.) Shear elongation at break (%) 50
- 4.) Peel strength (lb./in) 75 (65 extrusion weld)
- 5.) Peel separation (%) 25
- 6.) A geomembrane seam sample passes the field testing when:
 - a.) the break is a film tear bond (FTB); and
 - b.) the seam strength meets the required strength values for peel and shear given previously in Section 01 60 00 -

c.) For dual track welds, both welds must pass.

7.) Elongation measurements should be omitted for field-testing.

3.14 REPAIR PROCEDURES

A. GEOMEMBRANE COMPONENT:

1. The GEOSYNTHETICS INSTALLER shall be responsible for repair of damaged or defective areas.

B. Agreement upon the appropriate repair method will be decided between the OWNER'S REPRESENTATIVE and the GEOSYNTHETICS INSTALLER.

1. Procedures available include:

a. Patching:

1.) Used to repair holes (over 1/4-inch diameter), tears (over 1/4 inch long), undispersed raw materials, and contamination by foreign matter.

2.) Grinding and welding:

a.) Used to repair pinholes, and blemishes.

3.) Capping:

a.) Used to repair large lengths of seams.

4.) Removing the seam and replacing with a strip of new material.

b. The CQA Personnel will observe and document the following:

1.) The surface of the geomembrane component is clean at the time of inspection.

2.) Non-conforming geomembrane component is removed and replaced;

3.) Any portion of the geomembrane component exhibiting a flaw identified as defective by the POR or CQA PERSONNEL is replaced;

4.) Repair areas are distinctively marked and the required type of repair is indicated.

c. Repair Methods:

- 1.) Geomembrane surfaces to be repaired will be abraded (extrusion welds only) no more than 1/2 hour prior to the repair.
- 2.) All geomembrane surfaces will be clean and dry at the time of repair.
- 3.) The repair procedures, materials, and techniques will be approved in advance of the specific repair by the OWNER'S REPRESENTATIVE.
- 4.) Patch Requirements:
 - a.) will be a minimum of 12 inches in diameter with all corners rounded; and
 - b.) Will extend at least 6 inches beyond the edge of the defect.
 - c.) Temporarily bond the patch to the geomembrane with an approved method;
 - d.) Extrusion weld the patch; and
 - e.) Vacuum test the repair.

d. Repair Verification:

- 1.) CQA PERSONNEL shall number and log each patch repair
- 2.) CQC REPRESENTATIVE shall non-destructively test each repair using methods specified in Article 3.13.
- 3.) Provide daily documentation of non-destructive and destructive testing to the OWNER'S REPRESENTATIVE.
- 4.) The documentation will identify;
 - a.) Seams that initially failed the test; and
 - b.) Include the evidence that these seams were repaired and retested successfully.

C. ENGINEERED TURF COMPONENT:

- A. When Repairs and Tie-Ins of Engineered Turf occur, the CQA PERSONNEL must observe the following:
1. Repairs to Engineered Turf are completed by using a heat-bonded seam.
 2. All tie-in seams along flatter slopes (i.e. 15% or less) with length greater than

25 feet will use an approved heat bonded seam so as consistent pressure is achieved throughout the seam.

3. A hand held heat gun with a pressure wheel will be used in smaller/concentrated areas.
4. GEOSYNTHETICS INSTALLER may also demonstrate techniques and practices for Watershed Geosynthetics' approval.
 - a. Field demonstration and approval by the OWNER'S REPRESENTATIVE is required before incorporating any alternative technique.

3.15 INSTALLATION ACCEPTANCE

- A. The Geosynthetics Installer retains all ownership and responsibility for the ClosureTurf® system until acceptance by the Owner.
 1. After all ClosureTurf® components are deployed, seamed, has passed required testing successfully, and any repairs are made;
 - a. The completed installation will be inspected by the OWNER'S REPRESENTATIVE and the GEOSYNTHETICS INSTALLER'S CONSTRUCTION QUALITY CONTROL SUPERVISOR.
 - b. Damage and/or defects found during this inspection will be repaired by the GEOSYNTHETICS INSTALLER.
 - c. The installation will not be accepted until it meets the requirements of these specifications and any applicable State, Federal or Local Regulations.
- B. Installation of the ClosureTurf® system will be accepted by the POR only when the following has been completed:
 1. The installation is complete.
 2. Seams have been observed and documented by the CQA PERSONNEL and

accepted by the POR.

3. Required independent testing laboratory and field tests have been completed, reviewed and approved.
4. Required GEOSYNTHETICS INSTALLER supplied documentation has been received, reviewed and approved.
5. As built record drawings have been completed and verified by the POR.
6. Any other requirements shown in Section 01 73 19 – 1.04 D CLOSEOUT SUBMITTALS are complete and accepted by the POR.

END OF SECTION