Fabricated Geomembrane Institute

Field Seam-Test Frequency for Fabricated Geomembrane Panels

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1. Introduction and Scope

1.1 Factory seaming of geomembranes has been occurring successfully for many years and it provides many advantages over field seaming, including, optimal temperature, wind, and sunlight, dirt free, firm subgrade, and more attentive personnel for seaming. This always results in factory welds being better and more consistent than field seams and a better overall product. The large amount of factory seaming that can be performed also reduces the amount of field seaming. The ability to factory fabricate geomembranes provides many substantial benefits over geomembranes seamed in the field, such as higher quality and consistent seams, reduced installation time and cost, better visual inspection of the materials before installation, and less potential for construction induced damage.

However, some confusion has developed over the frequency of testing the small amount of field welded seams when installing factory fabricated panels in the field. The FGI, in cooperation with its members, developed this guideline for the test frequency of field welded seams to augment the existing guideline on the test frequency of factory welded seams which is now available as ASTM D7982.

1.2 In summary, this guideline is intended for use as a summary of destructive quality control test methods for determining the integrity of field seams used in the joining of factory fabricated

geomembrane panels in a geotechnical application. These test methods are applicable to manufactured flexible polymeric geomembranes/linings that are scrim reinforced or nonreinforced.

1.3 The types of field seams covered by this practice include the following as described under ASTM D4437:

1.3.1 *Hot Air*--A seam produced by applying high-temperature air or gas between two polymeric sheet surfaces, thus melting the surfaces, at which time pressure is applied to form a homogeneous bond between the two membrane surfaces.

1.3.2 *Hot Wedge* --A seam produced by melting the two intimate surfaces by running a hot metal wedge between the surfaces followed immediately by pressure to form a homogeneous bond.

1.3.3 Extrusion--A bonded seam produced by extruding molten parent material between or at the edge of two overlapped polymer sheet materials to effect a homogeneous melt between the two sheets to be joined.

1.3.4 *Solvent Bonded Seams*--A solvent is used to soften the surfaces to be bonded, followed by pressure to form a homogeneous bond.

1.3.5 *Bodied Solvent Bonded Seams*--The parent lining polymer material is dissolved in a solvent that is then applied in the same manner as a straight solvent, thus effecting a homogeneous bond.

1.3.6 *Adhesive Bonded or Cemented Seams*-- An adhesive system is used to bond two polymeric surfaces together. This system forms an adhesive bond between the sheet materials.

1.3.7 *Taped Seams*--An adhesive-based tape is placed between two polymer sheet materials forming a surface bond.

1.3.8 *Waterproofed Sewn Seams*--Seam fabricated by mechanical sewing of the overlapped sheet materials and sealed with an appropriate sealant as recommended by the sheet manufacturer.

1.4 Definitions:

1.4.1 *Trial Seam*--A seam made prior to or after production field welding, made by the same personnel, using the same geomembrane material, the same welding unit and the same seaming conditions used in the actual production seaming process. Trial seams are used to provide representative destructive test samples without damaging field seams.

1.4.2 *Destructive Test Sample* --A seam sample taken before, during, or after field production seaming that is used to determine the compliance of field production seams with a specification.

1.4.3 *Post-production test*—a destructive test sample tested at the conclusion of a set of field seams (production seam or trial seam) to qualify the previously produced production seams.

1.4.4 *Pre-production test* - a destructive test sample taken from a trial seam which is tested before production welding begins to qualify subsequent production seams.

1.4.5. *Field production seam* – a field seam that is made as part of the finished geomembrane.

1.4.6 *Field production seam cut-out* – a destructive test sample that is removed from a completed field production seam. The hole created by removing this cut-out must be repaired and tested.

1.5 The values stated in inch-pound units are to be regarded as the standard.

1.6 *This guideline may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this guideline to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Relevant Standards and Guidelines

ASTM Standards

D4437 Practice for Practice for Determining the Integrity of Field Seams Used in Joining Flexible Polymeric Sheet Geomembranes

D6214 Standard Test Method for Determining the Integrity of Field Seams Used in Joining Geomembranes by Chemical Fusion Methods

D6392 Standard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Method

D7700 Standard Guide for Selecting Test Methods for Geomembrane Seams

D7982 Standard Practice for Testing of Factory Thermo-Fusion Seams for Fabricated Geomembrane Panels

D7272 Standard Test Method for Determining the Integrity of Seams Used in Joining Geomembranes by Pre-Manufactured Taped Methods

D7408 Standard Specifications for Non Reinforced PVC (Polyvinyl Chloride) Geomembrane Seams

D7749 Standard Test Method for Determining Integrity of Seams Produced Using Thermo-Fusion Methods for Reinforced Geomembranes by the Grab Method

FGI Guidelines

FGI-2015 Guideline for Air Lance Testing Field Geomembrane Seams ()

Geosynthetic Research Institute Guidelines

GM-14 Selecting Variable Intervals for Taking Geomembrane Destructive Seam Samples Using the Method of Attributes

3. Field Seam Destructive Testing Frequency

3.1 The quality of field production seams must be verified by destructively testing sufficient frequency to provide confidence in the quality of the field seams produced. To that end, all field production seams must be bounded by passing destructive test samples at the beginning and end of each day's production seaming.

3.2 Destructive test samples can be taken from trial seams which can be prepared for either pre-production and post production tests. Destructive test samples can be taken from extra material that will be located at the end of a production seam where it enters the anchor trench (as a post-production test). Destructive test samples can also be removed from a cut-out within a production seam. This guideline specifically sets the frequency for destructive test sample cut-outs in production seams within a production seam. Any discontinuity in the production seam as a result of sample removal must be repaired.

3.3 Destructive test samples are to be tested using the appropriate ASTM test method. ASTM D7700 outlines the destructive and non-destructive test methods appropriate to most types of geomembranes. Test methods include ASTM D6214 for chemical fusion seams, ASTM 6392 for unsupported geomembrane types, ASTM D7272 for prepare tape seams, ASTM D7408 for PVC seams, and ASTM D7749 for reinforced geomembrane seam types.

3.4. Each destructive test sample prepared should be at least 3 ft long. The destructive test sample should be divided into three pieces, each 1 ft by 1 ft (300 mm x 300 mm). One piece should be taken by the installer and tested immediately, another by the owner's representative for laboratory testing, and the third one for archive. For field testing of destructive test samples, follow the project specifications for the number of specimens tested, follow the appropriate ASTM method, or test at least five (5) identical 1 inch (25 mm) wide samples must be tested for seam shear (2 samples) and peel (3 samples).

3.5. The results of each destructive sample test shall be recorded including location, seam number or test location, welding equipment used, technician performing the test seam and a pass or fail description.

3.6. Destructive Test Sample Testing Options:

3.6.1 Destructive test samples are taken from pre-production trial seams, post-production trial seams (or from extra material in the anchor trench), and from field production seam cut-outs.

3.6.2 While cut-outs in production field seams has been a common practice in the past the use of cut-out destructive test samples introduces an additional level of risk to a geomembrane as the defect created by the cut-out must be repaired. While geomembrane repair methods work well it is not the best practice to unnecessarily add repairs by cutting holes in the geomembrane for testing. The following options show how destructive test sample cut-outs can be reduced or eliminated.

3.6.3 **OPTION 1:** No cut-out samples

Geomembrane continuity test	Electrical Leak Location survey of the completed geomembrane	Select test method from ASTM D6747
Non-destructive testing of 100% of field seams	Air Channel Test method	ASTM D5820 or ASTM D7177
Pre-production test	Trial seam at start of day and every 4 hours of welding	Test destructive test sample with appropriate method
Post-production test	Trial seam at the end of the day's welding	Test destructive test sample with appropriate method
Production seam cut-outs	None	

3.6.4 **OPTION 2:** Cut-outs from non-critical locations

Non-destructive testing of 100% of field seams	Air Channel Test method or Air Lance	ASTM D5820, ASTM D7177, or ASTM D4437
Pre-production test	Trial seam at start of day and every 4 hours of welding	Test destructive test sample with appropriate method
Post-production test	Trial seam at the end of the day's welding (or end seam cut-out sample)	Test destructive test sample with appropriate method
Production seam cut-outs	Taken from the end of a seam of a size and location to not compromise production seam quality	Test destructive test sample with appropriate method

3.6.5 **OPTION 3:** Production seam cut-out at defined intervals

Non-destructive testing of 100% of field seams	Air Channel Test method or Air Lance	ASTM D5820, ASTM D7177, or ASTM D4437
Pre-production test	Trial seam at start of day and every 4 hours of welding	Test destructive test sample with appropriate method
Post-production test	Production seam cut-out will fulfill this requirement	n/a
Production seam cut-outs	Taken from production seams at an interval calculated by the method in Section 4.0	Test destructive test sample with appropriate method

4. Methodology for Computing the Frequency of Production Seam Cut-outs

4.1. The following steps and calculations are to be used to determine the test frequency of field seams used to join factory fabricated geomembrane panels for Option 3 in Section 3:

4.1.1 Initially cut-out a destructive test sample from a field production seam every 1,000 feet of field seam. Test the destructive test sample in the field using the appropriate destructive test method.

1.4.2 If any of the first ten (10) cut-out destructive test samples fail requirements, increase the frequency of cut-out destructive test samples to every 500 feet instead of every 1,000 feet.

1.4.3 If all of the first ten (10) cut-out destructive test samples pass requirements, then decrease the frequency of cut-out destructive test samples to every 1,500 feet instead of every 1,000 feet.

1.4.4 If all of the next ten (10) cut-out destructive test samples pass requirements, then the frequency can be decreased further to a cut-out destructive test sample every 2,000 feet instead of every 1,500 feet. The cut-out sampling distance of every 2,000 feet cannot be

increased further so the lowest cut-out sampling frequency for fabricated geomembranes is every 2,000 feet even if all subsequent destructive test samples pass requirements.

1.4.5 If any cut-out destructive test sample fails requirements then increase the frequency of cut-out destructive sampling to every 500 feet until ten (10) consecutive tests pass requirements. After ten (10) consecutive tests pass requirements, the frequency of cut-out destructive sampling can be increased by 500 feet until the sampling is at the minimum frequency of once every 2,000 feet. This iterative process is continued for the entire project.

5. Acknowledgments:

5.1 This guideline was prepared with the assistance of FGI Members and Timothy D. Stark and Jagrat B. Jariwala of the University of Illinois at Urbana-Champaign.