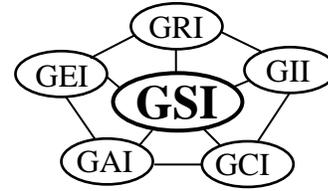


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adopted - 1995

## **GRI Test Method GM9\***

Standard Practice for

### **“Cold Weather Seaming of Geomembranes”**

This specification was developed by the Geosynthetic Research Institute (GRI) with the cooperation of the member organizations for general use by the public. It is completely optional in this regard and can be superseded by other existing or new specifications on the subject matter in whole or in part. Neither GRI, the Geosynthetic Institute, nor any of its related institutes, warrant or indemnifies any materials produced according to this specification either at this time or in the future.

#### **1. Scope**

- 1.1 This standard provides guidelines for the field seaming of geomembranes in cold weather. The applicable temperature range of the geomembrane sheet is from 0° to – 15°C (32° to 5°F). This practice, however, is not to be considered as all-encompassing since each material and site specific condition presents its own challenges and special conditions.
- 1.2 This practice is focused on thermal fusion and extrusion fillet seaming methods for the seaming of thermoplastic geomembranes.
- 1.3 This practice is intended to be a guide for those monitoring geomembrane installations as well as an aid to installers for the seaming of geomembranes in cold climates and conditions.
- 1.4 This standard may involve hazardous operations, equipment and climates. This standard does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

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\* This GRI standard is developed by the Geosynthetic Research Institute through consultation and review by the member organizations. This specification will be reviewed at least every 2-years, or on an as-required basis. In this regard it is subject to change at any time. The most recent revision date is the effective version.

## 2. Reference Documents

- 2.1 ASTM Standards:  
D4439 Standard Terminology for Geosynthetics
- 2.2 EPA Documents  
EPA/530/SW-91/051, “Inspection Techniques for Fabrication of Geomembrane Field Seams”  
EPA/600/R-93/182, “Quality Assurance and Quality Control for Waste Containment Facilities”

## 3. Terminology

### 3.1 Definitions of Generic Terms

- 3.1.1 *geomembrane* – An essentially impermeable geosynthetic composed of one or more synthetic sheets. (ASTM definition)
- 3.1.2 *destructive tests* – Tests performed on geomembrane samples cut from a field installation or test strip to verify specification performance requirements, e.g., shear and peel tests of geomembrane seams during which the specimens are tested to failure.
- 3.1.3 *seam shear test* – A destructive test in which two seamed sheets on opposite sides of the seam are pulled in tension placing the seam in a shear mode of stress.
- 3.1.4 *seam peel test* – A destructive test in which two seamed sheets on the same side of the seam are pulled in tension placing the seam in a tensile mode of stress.
- 3.1.5 *Construction Quality Control (CQC)* – A planned system of inspections that is used to directly monitor and control the quality of a construction project. Construction quality control is normally performed by the geosynthetics installer and is necessary to achieve quality in the constructed or installed system. Construction quality control (CQC) refers to measures taken by the installer or contractor to determine compliance with the requirements for materials and workmanship as stated in the plans and specifications for the project.
- 3.1.6 *Construction Quality Assurance (CQA)* - A planned system of activities that provides the owner and permitting agency assurance that the facility was constructed as specified in the design. Construction quality assurance includes inspections, verifications, audits, and evaluations of materials and workmanship necessary to determine and document the quality of the constructed facility. Construction quality assurance (CQA) refers to measures taken by the CQA organization to determine if the installer or contractor is in compliance with the

plans and specifications of the project.

### 3.2 Description of Terms Specific to This Standard

- 3.2.1 *field seams* – The seaming of geomembrane rolls or panels together in the field making a continuous liner system. Synonymous with *production seams*.
- 3.2.2 *trial seams* – Trial sections of seamed geomembranes used to establish machine settings of temperature, pressure and travel rate for a specific geomembrane under a specific set of atmospheric conditions for machine-assisted seaming as well as establishing procedures to be correctly used by the installation personnel.
- 3.2.3 *test strips* – Synonymous with “trial seams”.
- 3.2.4 *test welds* – Synonymous with “trial seams”.
- 3.2.5 *thermal fusion seams* – A seam which involves the temporary, thermally-induced reorganization in the polymer structure at the surface of two opposing geomembrane sheets which, after the application of pressure and the passage of a certain amount of time, results in the two geomembranes being permanently joined together.
- 3.2.6 *mouse* – Synonymous term for hot wedge, or hot shoe, seaming device.
- 3.2.7 *extrusion fillet seams* – A seam between two geomembrane sheets achieved by heat-extruding a ribbon of molten polymer over the overlap areas followed by the application of a nominal amount of pressure which results in the two geomembrane sheets being permanently joined together.
- 3.2.8 *gun* – Synonymous term for hand held extrusion fillet seaming device.

## 4. Significance and Use

- 4.1 Most federal and state environmental regulations call for special procedures for field seaming of geomembranes when sheet temperatures are less than 0°C (32°F). This standard practice is meant to give procedural guidance for seaming of geomembranes at sheet temperatures down to –15°C (5°F). Geomembrane seaming at temperatures below –15°C (5°F) is not generally recommended from both material and personnel perspectives.
- 4.2 The standard is focused on the two main types of thermal seaming methods, thermal fusion and extrusion fillet methods, where trial seam tests and production seam tests can be conducted within minutes after the seam is fabricated.

## 5. Procedure

### 5.1 Preparation of the geomembrane surfaces to be seamed:

- 5.1.1 Seaming is not to take place when it is snowing, sleeting or hailing on the geomembrane in the area to be seamed.
- 5.1.2 In the area to be seamed, all frost must be removed from the opposing surfaces of the geomembrane sheets in the regions where the actual seaming is to be performed.
- 5.1.3 The residual moisture left after removing frost must be wiped dry.

Note 1: Perhaps the most difficult surfaces to prepare in this regard are textured geomembranes where the texturing extends to the roll edges or roll ends.

- 5.1.4 The application of heat to remove moisture using a hand held hot air device can be used providing care against excessive heat application is taken. An assessment using trial seams is recommended.
- 5.1.5 The specific area to be seamed must be free of soil particles and other foreign matter.
- 5.1.6 For thermal fusion welding, such as the hot wedge method, the under side of the lower sheet should be free of frost so that the lower drive wheels of the device can move evenly and do not slip.

Note 2: It may be necessary to use a rub sheet beneath the area being seamed to separate the geomembrane from frozen soil subgrade.

- 5.1.7 For fillet extrusion welding the thermal tacking of the sheets together should proceed as with similar welding at temperatures above freezing.
- 5.1.8 Preheating of the geomembrane area to be seamed is common but the amount of preheat and its timing preceding the actual production seaming is at the option of the installer based upon past practice and experience. An assessment using trial seams is recommended.

### 5.2 Thermal fusion seaming (e.g., using a hot wedge welding device):

- 5.2.1 In general, the rate of seaming, i.e., the speed of the hot wedge device, is usually slower than when seaming at temperatures above 0°C (32°F). Furthermore, the rate should decrease with decreasing sheet temperature.

5.2.2 Cold temperature seaming requires more frequent trial seams than when welding at temperatures above freezing. For example, if the CQA plan calls for two trial seams a day at temperatures above freezing, the number should be increased by one per day for each 7.5°C (13.5°F) less than freezing. Trial seams should be made at the discretion of the CQA Engineer.

5.2.3 Cold temperature seaming may also require more destructive tests on production seams than when welding above freezing. For example, in addition to the CQA plan written around above freezing temperatures, additional destructive seam samples may be taken at the end(s) of each continuous production seams.

Note 3: The actual schedule for destructive test samples is at the discretion of the CQA Engineer.

5.2.4 Movable enclosures (i.e., tents) traveling along with the welding device and personnel are particularly effective at sites with high wind. Cold temperature, per se, will not demand the use of protective tents. The decision to use tents is that of the installer and CQC personnel.

### 5.3 Extrusion fillet seaming:

5.3.1 The necessary grinding of the geomembrane surfaces in preparation of placing extrudate should be no further ahead of the extrusion gun than 10 m (30 ft.), or as stated in the CQA plan.

5.3.2 At the discretion of the parties involved, the profile of the base of the extrusion gun barrel is often shaped more rectangularly than when seaming at temperatures above freezing. The reason for this is to minimize the cooling rate in the thinner extrudate regions, see Figure 1.

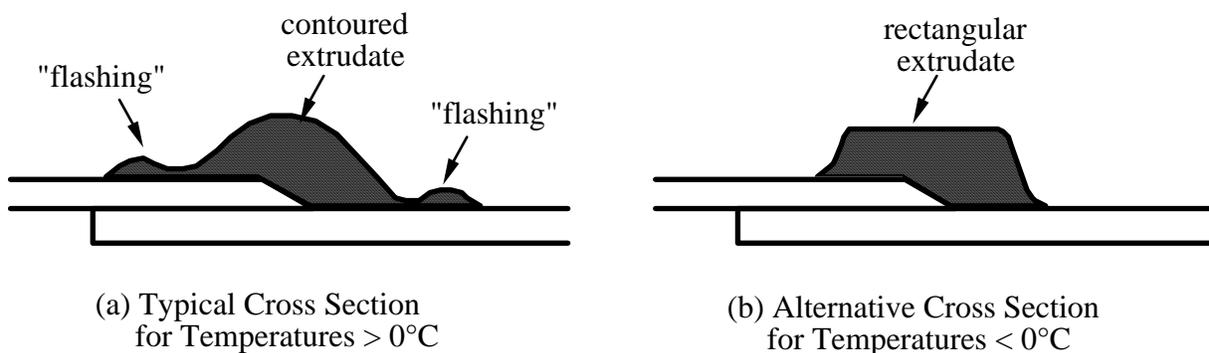


Figure 1 - Extrusion Fillet Patterns

- 5.3.3 In general, the rate of seaming, i.e., the speed of travel, is slower than when seaming at temperatures above 0° (32°F). Furthermore, the rate should decrease with decreasing sheet temperatures.
- 5.3.4 Cold temperature seaming requires more frequent trial seams than when welding at temperatures above freezing. For example, if the CQA plan calls for two trial seams a day at temperatures above freezing, the number should be increased by one per day for each 7.5°C (13.5°F) less than freezing. Trial seams should be made at the discretion of the CQA Engineer.
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#### 5.4 Seam Testing

- 5.4.1 In general, destructive testing of seams (both shear and peel) made in cold temperatures should follow the same protocol and test methods as for temperatures above freezing.
- 5.4.2 Destructive seam samples for CQA purposes should be taken as described previously and sent to the laboratory for testing at the designated test method conditions for above freezing temperatures.
- 5.4.3 Seam tests from trial seams can be taken to a field trailer, allowed to equilibrate to the designated test temperature and tested accordingly. However, seam tests from trial seams which are tested with a tensiometer on-site at temperatures less than freezing cannot be compared to geomembrane sheet strengths at room temperature. Numerous invalid results will occur if this procedure is practiced. Instead, the field tensiometer must be used to determine the strength of the unseamed geomembrane sheets at the same temperature as the seam test. The apparent strength will be higher as the temperature of the test specimen decreases. Acceptance of the trial seam is then based on the percentages of sheet strength as prescribed in the CQA plan, e.g., 95% in shear and 62% in peel for HDPE geomembranes.

Note 5: This type of testing whereby the seam test specimen results are compared to a single value of sheet strength is contentious since the value of sheet strength is not statistically reliable. Caution in this regard is necessary.

## **6. CQA Report**

- 6.1 The report should include hourly temperatures during cold weather seaming which includes the actual temperature of the surface of the geomembrane (using a pyrometer) and the ambient air temperature measured approximately 1 m (3 ft.) above the geomembrane.
- 6.2 The method of removing frost from the area to be seamed (if any is present), as well as drying and cleaning of the surfaces involved, should be described.
- 6.3 The condition of the subgrade beneath the area being seamed should be assessed. If a rub sheet is used during the seam process it should be noted.
- 6.4 Complete identification of the field seaming system used, including material, methods, preheat, seaming rate, use of tents or enclosures and other details of the procedure should be documented.
- 6.5 The type, nature, number, condition and details of trial seams, as well as the results of such tests, should be detailed.
- 6.6 The type, nature, number and details of destructive samples and disposition of sections of the sample should be described. Proper identification is required to identify results of CQA laboratory testing in the final as-built plans of the project.
- 6.7 Any unusual condition with respect to personnel, equipment, sampling and/or testing that may be attributable to the cold weather should be described and documented.