



Standard Specification for Air Channel Evaluation of Polyvinyl Chloride (PVC) Dual Track Seamed Geomembranes¹

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^{ε1} NOTE—Designation was changed to dual and units information was corrected editorially in June 2015.

1. Scope

1.1 This specification covers a nondestructive evaluation of the strength and continuity of parallel PVC geomembrane seams separated by an unwelded air channel. The unwelded air channel between the two distinct seamed regions is sealed and inflated with air to a predetermined pressure. Long lengths of seam can be evaluated by this specification more quickly than by other common nondestructive tests.

1.2 This specification can be used as a substitute for destructive testing or used in conjunction with destructive testing.

1.3 This specification covers PVC sheet 0.760 mm [0.030 in.] and thicker.

1.4 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

1.5 *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 standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:²

D4439 Terminology for Geosynthetics

¹ This specification is under the jurisdiction of ASTM Committee D35 on Geosynthetics and is the direct responsibility of Subcommittee D35.10 on Geomembranes.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

3. Terminology

3.1 Definitions:

3.1.1 *dual seam, n*—a geomembrane seam with two parallel welded zones separated by an unwelded air space.

3.1.1.1 *Discussion*—The dual seam itself can be made by a number of methods; hot wedge, hot air, and ultrasonic bonding are all typical techniques.

3.1.2 *geomembrane, n*—an essentially impermeable geosynthetic composed of one or more synthetic sheets.

3.1.3 *seam, n*—a permanent joining of two or more materials.

3.2 For definitions of other terms, see Terminology D4439.

4. Summary of Specification

4.1 This specification utilizes a dual seam where an air channel exists between the two welded zones. Both ends of the air channel are sealed and then a pressure gauge is attached to the air space. Air pressure is applied and the gauge is monitored.

4.2 Air pressures used in this specification are related to the ambient temperature of the PVC geomembrane and can be used for thickness 0.760 mm [0.030 in.] and thicker PVC geomembrane. The air pressure is not dependant on thickness of the PVC geomembrane being tested.

4.3 The minimum monitoring time is recommended to be ½ min (30 s) following stabilization of the pressure.

5. Significance and Use

5.1 The increased use of geomembranes as barrier materials to restrict liquid or gas movement, and the common use of dual track seams in joining these sheets, has created a need for a standard nondestructive test by which the quality of the seams can be assessed for continuity, water tightness, and strength. The test is also intended to provide an indication of the physical peel strength of the PVC seam.

5.2 This specification recommends an air pressure test within the channel created between dual seamed tracks whereby the presence of un-bonded sections or channels,

voids, discontinuities, foreign objects, and the like, in the seamed region can be identified.

5.3 This technique is intended for use on seams of PVC Geomembrane sheets 0.760 mm [0.030 in.] and thicker formulated from the appropriate polymers and compounding ingredients to form a polyvinyl chloride sheet material that meets all specified requirements for the end use of the product.

5.4 This test is used to assure minimum peel strengths are met through the entire seam area.

5.5 This test measures the seam strength to 2.6 kN/m [15 lb/in.] width minimum peel strengths.

5.6 This procedure is based on an air channel width of 15.87 ± 3.17 mm [0.625 ± 0.125 in.]. For air channels greater or lesser in lay flat width use the formula below to calculate hoop stress.

5.7 *Hoop Stress (Barlow's Formula)*—The stress in a channel wall acting circumferentially in a plane perpendicular to the longitudinal axis of the channel and produced by the pressure of the air in the channel.

5.7.1 *Hoop Stress Calculation:*

$$S = \frac{PD}{2t} \quad (1)$$

where:

S = hoop stress, psi,

P = internal pressure,

D = outside diameter of the channel, in., and

t = normal wall thickness, in.

6. Equipment

6.1 *Sealing Equipment*, appropriate to seal the two ends of the air channel.

6.2 A device is necessary to insert air into the open channel and allow monitoring its pressure. This device is unique to each user.

6.3 *Air Pump or Air Pressure Supply*, capable of generating up to 517 kPa [75 psi] pressure is necessary.

6.4 *Pressure Gauge*, capable of indicating the air pressure in 7 kPa [1 psi] increments within the test range.

6.5 Any equipment used on the geomembrane must be placed on an adequate cushion to preclude damage to the geomembrane.

6.6 *Flexible Hose*, used to connect the air supply to the air pressure device.

6.7 *Knife or Scissors*, capable of cutting or trimming the liner material.

6.8 *Infrared or Probe Type Thermometer*, able to measure the sheet temperature to an accuracy of ±1.1°C [±2°F].

NOTE 1—All gauges should be calibrated as specified by the manufacturer, or at a frequency of at least once per year.

NOTE 2—A change of 1°F equals a change of 5/9 = 0.56°C.

7. Procedure

7.1 After the dual track seam is fabricated and the length of seam that is to be evaluated is determined, seal one end of the continuous air channel with a clamp.

7.2 Connect the pressure gauge and air insertion tool directly into the air channel.

7.3 Connect an air supply to the pressure gauge and insertion tool and pressurize the air channel to the pressure appropriate for the PVC geomembrane sheet temperature. (Refer to Table 1.)

7.4 Maintain the minimum pressure from the source for a minimum of 30 s.

7.5 Inspect the seam from the clamped end for complete inflation. If the seam completely inflates and there is no audible or visible evidence of air leakage, the seam passes the test.

7.6 If the channel will not pressurize there is a leak in the seam, provided air is not leaking at the clamp or air supply tool.

7.7 Inspect the seam from the clamped end and locate the leak area. Because of the flexibility and elongation factors of a PVC geomembrane a leak can be detected by sound. Another technique to locate a leak is to have an additional clamp and at 10 ft increments clamp off the channel to locate the air leak. Because of the flexibility of PVC geomembrane, a wrinkle can be made in the seam area and folded over on itself and clamped.

7.8 At completion of the test open the air channel at the end opposite the pressure gauge. Air should rush out and the pressure gauge should register an immediate drop in pressure, indicating that the entire length of the seam has been tested. If not there is a blockage in the seam.

7.9 Mark both ends of the seam with the inspector's initials, seam identification letter or numbers, or both, length inspected, date, sheet temperature and test pressure.

7.10 Any dual seam that cannot be successfully tested using this specification should be marked and tested using another nondestructive testing practice.

NOTE 3—Leaks around the end seals and air pressure device can usually be located by putting moisture around the suspected area and looking for air bubbles.

TABLE 1 Pressure Required to Verify 15 lb/in. Seam Peel Strength for PVC

NOTE 1—Data for this chart is acquired from research papers in Section 2 and the bibliography.

Sheet Temperature °C	Sheet Temperature °F	Air Pressure kPa	Air Pressure psi	Hold Time
4.5	40	414	60	30 s
7	45	386	56	30 s
10	50	358	52	30 s
13	55	324	47	30 s
15.5	60	290	42	30 s
18	65	276	40	30 s
21	70	248	36	30 s
24	75	234	34	30 s
26.5	80	200	29	30 s
29.5	85	186	27	30 s
32	90	172	25	30 s
35	95	165	24	30 s
37.5	100	152	22	30 s
40.5	105	138	20	30 s
43.5	110	131	19	30 s

8. Corrective Action

8.1 *Air Channel Blockage*—Camp at the blockage and test both directions. Due to the flexibility of PVC Geomembranes, Inflation of the air channel up to the blockage is very visible. Therefore releasing the air pressure at the testing device is acceptable in this situation.

8.2 *Seam*—When a seam failure is detected the seam should be retested on both sides of the failure if the two parts pass then repair the area. If the seam failures continue the onsite CQA and installer shall discuss and agree on corrective action to repair or to rebuild the seam.

NOTE 4—This test purposes to measure the strength and continuity of the seam. If repeated failures occur the seam shall be rebuilt.

9. Report

9.1 The report should include the seam identification letter or numbers, or both, date and time of inspection, inspector's identification, length of seam tested; sheet temperature, test pressure and pass fail results. If fail, corrective action should be described in detail.

10. Keywords

10.1 air channel; canal; destructive test; dual track; flexible sheeting; geomembrane; landfill; non-destructive test; poly(vinyl chloride); polyvinyl chloride resin; pond liner; PVC; reservoir; water containment membrane; water leakage resistance

BIBLIOGRAPHY

- (1) Thomas, R. W. and Stark, T. D., "Air Channel Testing of Thermally Bonded PVC Seams," September 4, 2002.
- (2) Thomas, R. W., Stark, T. D., and Choi, H., "Air Channel Testing of Thermally Bonded PVC Seams," *Geosynthetics International Journal*, Industrial Fabrics Association International (IFAI), Vol 10, No. 3, October 2003, pp. 645-659.
- (3) Thomas, R. W. and Stark, T. D., "Air-Channel Testing of Thermally Bonded PVC Geomembrane Seams," *Geotechnical Fabrics Report*, Industrial Fabrics Association International, Vol 20, No. 8, October 2003, p. 10.
- (4) Stark, T. D., Choi, H., and Thomas, R. W., "Low Temperature Air Channel Testing of Thermally Bonded PVC Seams," International Association of Geosynthetic Installers, Industrial Fabrics Association International (IFAI), Vol 4, Issue 1, Winter 2004, pp. 5-7.

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