IAGI Polyethylene Certification Study Guide

International Association of Geosynthetic Installers

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1. Pre-welding sequence

1. Proper set up and preparation of equipment.
2. Run test seam sample successfully.
3. Cut coupon and sample preparation.
4. Test coupon with field tensiometer.
   - Knowledge of the pass/fail criteria for test welds
   - Initial set up
   - Specimen placement
   - Testing
   - Documentation

2. Trial welds

1. Make weld – extrusion and fusion welds.
2. Cut sample coupons.
3. Test sample in field tensiometer.
4. Determine if seam meets pass/fail criteria.
5. Make adjustments to equipment if initial welds are unacceptable and re-weld trial samples.
6. Retest if necessary.
7. Properly document results in logs.

3. Welding

A. Wedge

1. Set nip compression rollers to proper width dependent on material thickness.
2. Set wedge welder to center the hot wedge between the nip rollers.
3. Set temperature control to suggested starting temperature range.
4. Set speed control to achieve the desired travel speed at which the welding machine must travel to produce a quality weld.
5. Ensure that proper geomembrane overlap is maintained during seaming.
6. Make sure surfaces are clean and free of moisture.
7. Determine if a protective barrier (i.e. rub sheet) is necessary due to subgrade conditions.
8. Determine if weather conditions are appropriate for welding.
9. The forward face of the welding machine should be inspected for sharp corners and irregular details that may damage the liner as the machine moves forward during the seaming process.
10. A small amount of “squeeze-out” is a reliable indication that proper seaming temperatures have been achieved. Excessive extruded hot melt or geomembrane sheet wrinkling indicates that excessive heat or pressure or both may have been applied. Adjust temperature and/or pressure to correct the situation.

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B. Extrusion

1. Set recommended or correct preheat temperature.
2. Set barrel extrusion temperature control to the proper or recommended temperature required for welding material.
3. Allow the equipment to preheat according to manufacturer's instructions.
4. Ensure welding rod is clean and dry.
5. The extrusion welder barrel must be purged before starting and after welding.
6. Geomembrane sheets or patch must overlap by at least six inches. (S.I. units = 150 mm)
7. The geomembrane overlap must be clean and dry.
8. Ensure extrudate is centered over the exposed geomembrane overlap edge.
9. Ensure visible grind marks beyond the edge of the extrudate are limited to 0.25 inches maximum.
10. Extrudate depth at center should be approximately twice sheet thickness. Excessive squeeze-out is acceptable, if it is equal on both sides and will not interfere with vacuum box testing.
11. Select the extrusion shoe necessary to provide the bead cross section required. The angle of the shoe needs to match the weld – flat, corner, angle, size of bead etc.
12. When possible, inspect the underside of the lower liner for heat distortion. This can be done at the end of the seams and/or wherever destructive samples are taken. Slight puckering on liners 60 mil (1.5mm) and less is acceptable. For liners greater than 60 mils no puckering should take place. Adjust temperature or speed of seaming to correct problem.

C. Grinders

1. Grinder approximately 4 inches (100mm) in diameter.
2. #80 grit sandpaper or #100 grit if material is less than 40 mil (1.0 mm).
3. Sandpaper coarser than #80 can leave deep grooves in the weld area, which represent potential stress or thin points.
4. Grind marks should never be deeper than 10 percent of sheet thickness.
5. Grinding marks should extend less than ¼ inch (6mm) on either side of extrudate after welding.
6. Grind less than 30 minutes prior to welding.

4. Knowledge of seam preparation

1. Dry & clean.
2. Ensure proper overlap length.
3. Verify suitability of subgrade.

5. Continuously monitor machine performance

1. Ensure that the equipment operates within the acceptable temperature and speed parameters.
2. Monitor temperature readout and speed of machine.
3. Ambient variables such as temperature, cloud cover, and wind speed may make it necessary to adjust wedge temperature due to effects on geomembrane temperature during welding.

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4. On soft subgrade the welding machine may tend to “bulldoze” into the ground as it travels, causing soil to enter the weld. The operator should slightly lift the front of the welding machine to avoid this situation, or use a sled or rub sheet.

6. Maintain seam overlap criteria

1. Check tracking for overlap and air channel continuity.
2. Excessive undulation (waves) along the seams cause fishmouths. Operator of welding equipment must make appropriate adjustments.

7. Record temperatures / start & stop time

1. Record machine temperatures and settings into log book (trial weld only).
2. Record machine identification number, operator's initials, panel numbers, date and start time on liner at beginning of each seam.

8. Safety concerns

1. Be aware of all onsite specific safety requirements.
2. Check all equipment daily for proper operation.
3. Inspect wires and plugs for frays, grounding, etc.
4. Sand bag requirements.

9. Repair procedures

A. General understanding of sources of seam failure.

1. Moisture, dirt, etc.
2. Improper speed, temperature, and pressure settings.
3. Understand that no more than 10 percent peel of the width of the seam is acceptable.
4. Grinding.
5. Adjusting for fishmouths.
6. Understand film tear bond (FTB – failure only in parent material and not the seam area are acceptable).

B. Basic geomembrane repair procedures (grinding – extrusion gun).

1. Patch size and overlap [typically 6 inches (150 mm) per specification].
2. Trace failed destructs 10 feet (3 m) per side of failed sample and retest seam. Cap strip length of seam between two passing destructive samples.
3. Avoid trapped air under larger patches.

10. Appurtenances

A. Installation of pipe boots and appurtenances/mechanical attachments

1. Welding requirements – overlap, grinding.
2. Subgrade requirements, proper compaction.
3. Knowledge of acceptable concrete conditions – smooth surface and minimum thickness needed for drilling.

B. Boot construction

1. Skirt size.
2. Sleeve length.
5. Number of clamps and type of gasket.

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6. Fabrication and welding technique.
7. Testing.
8. Clamps or banding.

C. Batten Bar
1. Bolt spacing and depth of drilling.
2. Bolt compression drilling.
3. Proper use of gasket and caulking.
4. Geomembrane protection.

11. Maintenance of equipment

A. Wedge
1. Keep the wedge clean to prolong wedge life.
2. Clean by brushing off the hot wedge and removing small rocks and soil from the lower contour rollers area after each seam.
3. Clean all gear sprockets and chains with cleaning solvent. Wipe or blow-dry with compressed air.
4. Ensure components are clear of soil.
5. Lightly lubricate required components.
6. Inspect chains for proper adjustment.
7. Inspect all other screws.
8. Inspect voltage of plugs and correlate to electrical cord length.

B. Extruder
1. Be sure to purge barrel of extrudate prior to turning machine off.
2. Allow machine to cool off at least 5 to 10 minutes before unplugging.
3. Inspect brushes in motor.
4. Ensure that the drive motor is cleaned and checked per manufacturer's recommendation.
5. Ensure that the drive motor and gears are greased.

C. Vacuum Box Tester
1. Clean viewing window with non-abrasive cleaners such as window cleaners
2. Store in shipping case when not in use.
3. Shave gasket or re-glue gasket as needed.
4. Prepare proper soap solution.

12. Testing

A. Knowledge of pass/fail criteria
1. seam strength psi (kPa) – peel and sheer per attached minimum average weld properties (see attached minimum average weld properties).
2. 4 of 5, 5 of 5, average, minimum, etc.
3. Significance of strength values.
4. Film tear bond.

B. Significance of shear elongation and peel separation values.

It is not sufficient that the seam shear specimen fail outside the weld, it must also fail in a ductile manner. If elongation is severely reduced, the seam may have been overheated or grinding may have been excessive, both of which might reduce the durability of the seam. If peel separation occurs, the damage that is introduced into the separated surfaces may significantly reduce the stress cracking resistance of the remaining seam segment.

C. Basic understanding of nondestructive testing

C-1. Vacuum Box Tester

1. Prepare vacuum assembly for testing.
2. Apply soap and water solution generously to seam areas to be tested. The seam section must be longer than the vacuum box.
3. Place vacuum box over test area.
4. Turn vacuum box on.
5. Apply pressure downward to viewing box to create vacuum and seal, observe seam area for 5-10 seconds. (IAGI Specification Committee specifies 5 seconds, US EPA specifies 10 seconds.)
6. Verify constant pressure at approximately 5 psi (125 kPa).
7. Once test is completed, turn machine off.
8. All vacuum pressure to subside before moving to next test area.
9. If no bubbles are observed, then the test passes. Reposition the box on the next wetted area for testing with a slight overlap.
10. If bubbles are observed, which indicates a leak in the seam, mark that section for repair and retest.

C-2. Air Channel Testing

The equipment is comprised of the following:

1. An air pump, or air tank, capable of producing a minimum air pressure of 25 psi (175kPa) in the seam channel.
2. A sharp hollow needle to insert air into the air channel of the seam.
3. A hot air gun or other heating device to seal the ends of the air channel.

The following procedures shall be followed:

1. Seal both ends of the air channel of the seam to be tested.
2. Insert the needle into the air chamber at either end of the seam to be tested.
3. Pressurize the air channel to a minimum of 25 psi (175 kPa). Allow the pressure to stabilize, and if necessary, re-pressurize to 25 psi (175 kPa) and note the pressure.
4. With a minimum pressure of 25 psi (175 kPa) stabilized in the air channel, the time of day will be noted.
5. After approximately 5 minutes, read the air pressure again.
6. If the difference between the two readings is more than 4 psi (27 kPa), the seam needs to be retested.
7. Upon completion of the test and recording all information required, open the opposite end of the seam from the needle. Escaping air will confirm that the entire length of the seam was pressurized and therefore tested. If air does not escape, the channel is blocked. The blockage must be located and the test redone from that point on.
8. Upon completion of the air pressure test, the seam shall be marked and points requiring repair identified.

Procedures for air pressure test failure:
Should the seam fail the air pressure test, the following procedure shall be followed.

1. Reposition the apparatus and retest the same section.
2. While the seam air-channel is under pressure, traverse the length of the seam and listen for the leak.
3. While the seam air-channel is under pressure, apply a soapy solution to the seam edge (do not trim excess material from edge of seam) and observe for bubbles formed by escaping air.
4. Re-test the seam in progressively smaller increments, until the area of leakage is identified.
5. Repair the identified leak area by extrusion welding the excess material at the edge of the seam and then vacuum test.
6. In areas where the air channel is closed and the integrity of the weld is not suspect, vacuum testing is acceptable.

13. Basic Field terminology

1. Geomembrane type – smooth and textured, HDPE, VFPE, polyethylene.
2. Types of equipment used – grinder, hot air gun, extrusion welder, wedge welder, tensiometer.
3. Shear test.
4. Peel test.
5. Subgrade acceptance.
6. Engineer/Q.A. Engineer.
7. Stress cracking.