



Certified Welding Technician (CWT)  
Program / Polyethylene  
Proctor Instruction Guide for Polyethylene





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## Introduction:

The International Association of Geosynthetic Installers' Proctor's Manual has been developed to ensure that the certification tests are administered uniformly. Please follow all the guidelines as written in this manual.

IAGI is continually working to enhance this certification program. If you have suggestions for improving this process, please contact IAGI's Managing Director at +1 (720) 353-4977 or [iagi@iagi.org](mailto:iagi@iagi.org).

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## Getting started:

The basic steps for getting started with the program are outlined here. In all cases, the information written in the manual will supersede the general guidelines written below:

1. **Experience:** The first requirement is that test candidates meet the minimum experience level. They must have 1,000,000 square feet (90,000 square meters) of experience on more than five (5) different jobs. They will be asked to provide a resume of the experience and a government-issued identification card.
2. **Proctor:** A proctor is needed to coordinate and oversee the exam process. Proctors are listed on the IAGI website.

We recommend that you look to your suppliers for proctors. Make arrangements directly with the proctor. While IAGI strongly recommends that you use a proctor experienced in giving this exam, you can arrange to have someone local conduct this for you. All proctors are required to go through an IAGI training program to administer the exam. Contact IAGI for more information.

One proctor may test a maximum of 12 people at a time. More than 12 candidates require a second proctor or two days of testing.

3. **Set Date:** Select a date to conduct the tests in conjunction with proctor.
4. **Assemble the materials:** The certification exam requires the use of a variety of material types in order to comply with the exam requirements. Be sure to follow the proctor booklet guidelines in assembling the right mix of products. Pre-cut all materials in advance of the testing to make the process go smoothly.
5. **Set up the test area:** Set up a room with plenty of space between candidates to take the written exam. The hands-on portion can be conducted in your warehouse. Allow plenty of space for each candidate to conduct their welds.
6. **Test Preparation:** The test candidate is encouraged to review the study guide.



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## Receipt of Testing Materials

Please check that your order contains:

- ◆ Guidelines for the Written Test (3 pages)
- ◆ Guidelines for the Hands-on Test (4 pages)
- ◆ Proctor Report (3 pages)
- ◆ GM-19 Seam Strength Tables (2 pages)
- ◆ Test Booklets



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## Testing Day Procedures

**Proctor:** It is important for you to proceed through the instructions at a pace that allows the slowest candidates to keep up. One of the main reasons why candidates have failed the test is because of their failure to follow the directions. Therefore, please ask the test candidates to listen carefully to the directions.

**Photo ID required:** Test candidates must present a government-issued photo ID prior to beginning the test. They must also supply the Proctor with a photocopy of the ID which will be returned with the completed test to IAGI.

**Proof of minimum experience:** Each test candidate must provide documented proof that he/she has at least 1,000,000 square feet (90,000 meters squared) of installation experience of polyethylene geomembrane in any thickness on five (5) different jobs. A list of projects (resume) is sufficient. The proctor is responsible for verification of experience before starting the test. A copy of the resume must be returned with the completed test to IAGI.

**Verbal Exam:** In the event that someone cannot read or cannot read well enough to take the written exam, it can be read aloud to them. Either the Proctor can read the exam, or monitor someone who reads it to the test candidate. If the Proctor has someone else read the exam, they must monitor that the person reading the exam to prevent cheating.

**Translators:** Translators for the exam are permitted. However, once someone has translated the CWT exam they are no longer allowed to sit for the exam in the future. All translators must sign a confidentiality agreement prior to translating. Contact IAGI staff for instructions.

**Replace defective test booklets:**

If a candidate has a defective test booklet, replace it. Note the booklet number of both the defective booklet and the replacement booklet in the "Proctor Report".



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## Testing Day Procedures

### **Make sure there is no cheating:**

The Proctor(s) should walk around the room frequently to guard against cheating, copying questions or answers, removing test booklet pages, or any other actions threatening test security or the testing environment. Note any discrepancies in the "Proctor Report" supplied by IAGI contained with each test package.

### **Collect all materials after the test:**

Once the time allotted for the test has elapsed, collect all the test booklets. Be sure that candidates do not leave with any testing materials. Account for all test materials before candidates leave the room. Make sure there is one completed test for each test candidate. Record the number of completed tests in the "Proctor Report". Count the used test booklets. Make sure the number agrees with the number of tested candidates. You must return both used and unused test booklets. Note the quantities in the "Proctor Report".

Send the following items in one envelope/box to IAGI (address on page 2):

- Completed Tests
- Candidate ID's (photo copies)
- Candidate Resumes
- Completed "Proctor Report"
- Test Registration Log
- Unused Test booklets

All written test materials must be shipped to IAGI and all hands-on exams must be shipped to the third party laboratory on the first business day following the test. There are no exceptions to this rule. All test materials should be stored in a locked location until shipping.

To avoid lost or delayed return shipments, it is important to use a delivery service with a package tracking system.



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## Testing Day Procedures

### **Discrepancies:**

If IAGI finds discrepancies in the test material or accounting, IAGI will notify the Proctor to resolve the discrepancy. IAGI will not process the test batch until any discrepancies are resolved. Unresolved discrepancies may result in the test being declared invalid.

### **Test acknowledgment:**

Test candidates will receive notification regarding pass or failure from IAGI. Candidates who successfully meet testing requirements will receive a letter of congratulations, a certificate and a wallet card within six to eight weeks from the date all test materials are sent to IAGI and the laboratory.



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## Proctor Guidelines for the Written Test

The following guidelines should provide every candidate an equal opportunity to complete the test successfully. It is the responsibility of the Proctor to protect the integrity of this certification process and to provide an environment conducive to testing. If you have any questions regarding these guidelines, contact IAGI.

### Test Booklets:

- ◆ All test booklets should arrive individually packaged in clear plastic wrap.
- ◆ Do not open the clear plastic wrap on the test booklets. The test candidates will remove the clear plastic wrap once testing begins.
- ◆ Verify that you have received the correct number of tests in the correct language(s).
- ◆ Record the number of test booklets received in the “Proctor Report” in the section titled, “Order Data”.

Proctors are responsible for all testing materials in their possession. It is imperative that the Proctor safeguards the security of all test materials from the time the Proctor receives them until they are returned to IAGI. Test materials are strictly confidential and may not be reviewed before testing. Copying, transcribing, or removing the test materials is prohibited. Any breach in security should be reported to IAGI immediately. Keep the testing materials locked in a secure place until test time.

If you, as the Proctor, suspect someone does not read well, you are strongly urged to read the exam out loud. Reading out loud is permitted and encouraged when there is any doubt. Some proctors have made it a practice to read the exam regardless. Some test candidates may be reluctant to admit (especially in the presence of their employer) that they do not read / comprehend the written word well. Err on the side of reading out loud if you have any doubt. This is not a test to determine reading comprehension but rather one to test the level of knowledge the candidate has about the work they do.



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## Proctor Guidelines for the Written Test

### Writing Implements:

Bring an extra supply of writing implements in case the test candidates do not bring them. Pencils are recommended but not mandatory.

### Room set up:

The room set-up is important to successful testing. Be sure an adequate amount of space is provided to prevent copying; IAGI requires a minimum of one seat between each candidate. The space and physical facilities must allow the Proctor(s) continuous surveillance of the room. It is also advised that candidates should have a wall clock in sight.

### Quiet and comfortable test area:

A quiet and comfortable testing area enables candidates to do their best work without delays or distractions.

### Time Allocation:

A maximum of two hours is allotted to complete the written exam.

### No visitors:

No visitors are permitted in the testing room.



## Proctor Guidelines for the Written Test

	<b>Proctor's Instructions</b>	<b>Read aloud to the Test Candidates</b>
1.	Verify that there is sufficient spacing between candidates. Have candidates change seating if necessary.	Seat yourselves so that there is a minimum of one seat between each person.
2.	Distribute the sealed test booklets	These books are to remain sealed until you are instructed to remove the plastic.
3.	Announce time allocation	You will be given two hours to take the written portion of the test. The time remaining to take the test will be announced occasionally. You may not leave the room during this time.
4.	Announce Test Directions  [It is helpful to have the day's schedule available in advance. Specify what teams will be doing the hands-on test at what times. Allow 2 hours for each hands-on test.]	There are 60 questions and you must answer 65% of the questions correctly in order to pass. The test is a multiple-choice test. There is only one correct answer for each question. Circle the correct answer for each question.  There is to be no talking during the test. If you have a question or problem, contact the Proctor. If you talk during the test, the test will be taken away and you will fail the test.  Once you complete the test, be sure your name is on the cover and turn the test into the proctor. You may then leave the room. Return in time to begin the hands-on portion as announced by the proctor.
5.	Ask if there are any questions.	Are there any questions?
6.	Tell candidates to remove the plastic from the test booklet.	You may remove the plastic from the test booklet. Please print your name as you want it to appear on the certificate, date and company name on the front cover of the test.
7.	Begin the test	You may now begin the test. Good luck.



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## Guidelines for the Hands-on Test

### Number of candidates and room set-up:

For the hands-on portion of the certification, we recommend that a Proctor supervise no more than six (6) candidates taking the hands-on portion of the test at one time; however, more technicians can test if the space and equipment allows: organization is the key to success. The room set-up must allow enough room between each candidate to conduct welding. No talking or questions between candidates is allowed and they are not allowed to assist each other in making welds.

### Materials needed:

*It is the responsibility of the company requesting certification and/or the testing candidates to provide the equipment and geomembrane materials used for the hands-on test.*

The following is a list of specific Polyethylene materials with required mil thickness, surface type, and size for each test candidate. A minimum of one set per test candidate is required. Additional pieces of each material is suggested as a test candidate is allowed to weld 3 seams of each material prior to submitting one. Substitutions for geomembrane types / mil thicknesses are allowed only upon written approval from IAGI prior to test date:

### *Wedge Welding Hands-on Test:*

1 piece of 40 mil (1.0mm) smooth LLDPE geomembrane, 12" wide X 12 feet (30.5 cm x 3.7 meter).

1 piece of 40 mil (1.0mm) smooth HDPE geomembrane, 12" wide X 12 feet (30.5 cm x 3.7 meter).

1 piece of 60 mil (1.5mm) textured HDPE geomembrane, 12" wide X 12 feet (30.5 cm x 3.7 meter). (must be textured all the way to the edge).



Modified: November 2014  
 Revision 6 / November 19, 2014

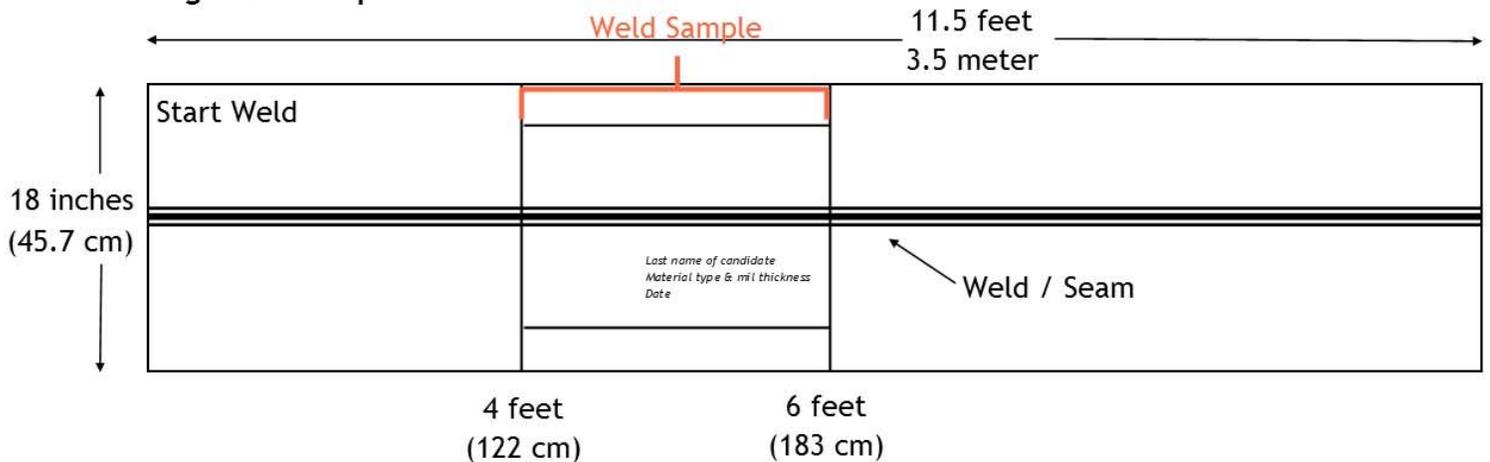
## Guidelines for the Hands-on Test

### Equipment Needed:

- Wedge welder
- Any tools needed for adjusting and/or fixing the welders in the event of machine failure
- Hook blade or similar for cutting geomembrane liners
- Field Tensiometer (one unit for every 4 test candidates is recommended)
- Test coupon cutter (Bone-Cutter)
- Writing implement for marking geomembrane samples

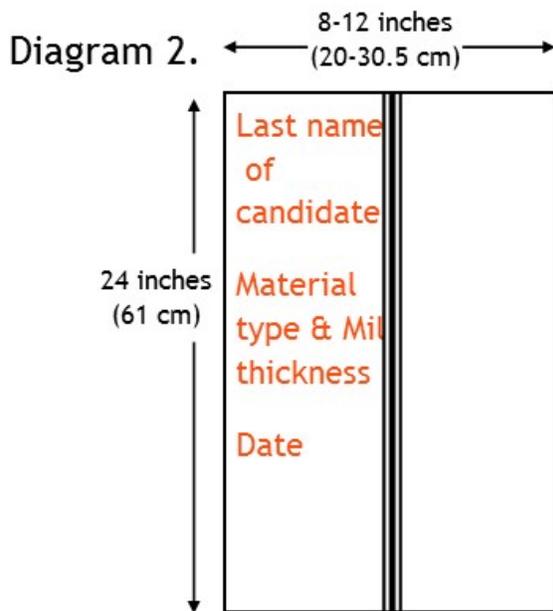
Each candidate should be given 1 piece (strip) of material, of various thicknesses, from the geomembrane pieces provided and instructed to cut approximately 11.5 feet long. If the material is pre-cut the testing will go faster. Extra pieces of each geomembrane are recommended.

**Diagram 1.**  
**Wedge Weld Coupon**





## Guidelines for the Hands-on Test



Cut the submission coupon starting at the four (4) foot mark. This allows for temperature drop and recovery period on fusion welds.

### *Extrusion Welding Hands-on Test:*

- 1 piece of 40 mil (1.0mm) smooth LLDPE geomembrane, 12" wide X 7 feet (30.5 cm x 2.1 meter).
- 1 piece of 60 mil (1.5mm) smooth HDPE geomembrane, 12" wide X 7 feet (30.5 cm x 2.1 meter).
- 1 roll of LLDPE or VFPE welding rod in appropriate diameter for extrusion welder used for test.
- 1 roll of HDPE welding rod in appropriate diameter for extrusion welder used for test.

### *Equipment Needed:*

- Extrusion welder and welding rod as noted above
- Any tools needed for adjusting and/or fixing the welders in the event of machine failure



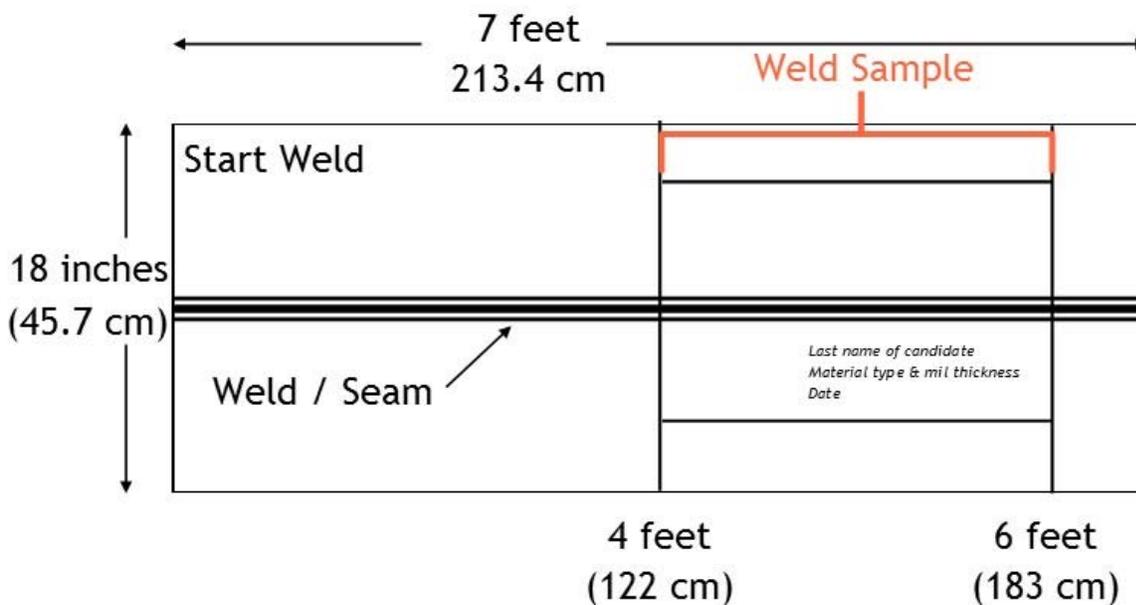
Modified: November 2014  
Revision 6 / November 19, 2014

## Guidelines for the Hands-on Test

- Hook blade or similar for cutting geomembrane liners
- Field Tensiometer (one unit for every 4 test candidates is recommended)
- Test coupon cutter (Bone-Cutter)
- Writing implement for marking geomembrane samples

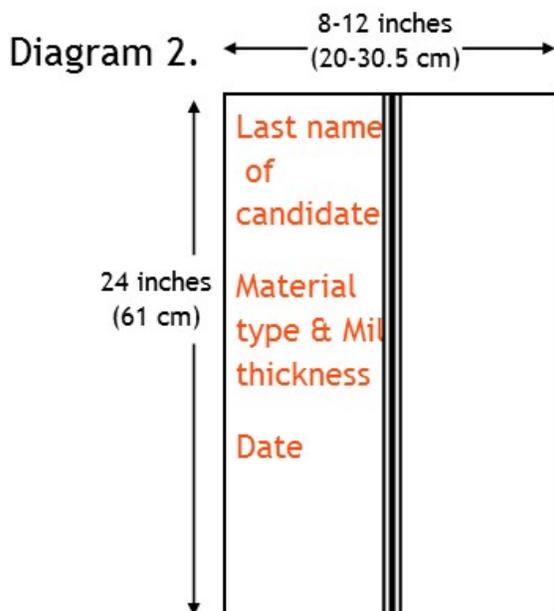
Each candidate should be given 1 piece (strip) of material, of various thicknesses, from the geomembrane pieces provided and instructed to cut approximately 7.0 feet (2.1 meter) long. If the material is pre-cut the testing will go faster. Extra pieces of each geomembrane are recommended.

**Diagram 3.**  
**Weld Coupon for Extrusion Welds**





## Guidelines for the Hands-on Test



Cut the submission coupon starting at the four (4) foot mark. This allows for temperature drop and recovery period on fusion welds.

**The Candidate sets up the machine and makes a weld in the liner:**

The candidate will take a final weld coupon from his/her weld per the **Diagram 1** for Wedge welded sample and **Diagram 3** for Extrusion welded samples. The candidate may cut coupons ("bones") and conduct as many peel and shear tests on the field Tensiometer as they desire to determine if they have a good seam. The candidate may not cut bones out of the coupon area to be submitted (the section of seam between 4 and 6 feet from the beginning of the weld).

**Each candidate can re-weld up to 3 (three) times:**

The candidate may seam up to three welds and then choose the best sample to submit. Once the candidate is ready to submit his/her sample, have them cut a sample per diagram 1 (below). The submission coupon should be trimmed to approximately 8-12 inches wide by 24 inches long. The seam will run parallel with the 24-inch edge. Have the candidates label the submission coupon as described in diagram 2. Place the sample in a sandbag or wrap them into a bundle and send to the laboratory for testing. Also label the bundle / sandbag with the test candidate's last name and note it is IAGI Certification Testing.



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## Guidelines for the Hands-on Test

### Lab selection:

The test candidate or candidate's company can choose the testing laboratory that will perform the destructive testing of submitted samples from the list. Send all labeled materials to one of the labs below and write the name of the sponsoring company on the box and internal packing labels. List that this shipment is for IAGI CWT exams for Polyethylene.

#### **SAGEOS**

Contact: Eric Blond  
3000 Boullé Street  
Saint-Hyacinthe, Québec J2S 1H9  
Canada  
Phone: +1 (450) 778-1870

#### **TRI/Environmental**

Contact: Sam Allen  
9063 Bee Caves Rd.  
Austin, TX 78733  
USA  
Phone: +1 (512) 263-2101

#### **TRI Australasia Pty Ltd**

Contact: Warren Hornsey  
Unit 12, 45 Township Drive  
Burleigh Heads, QLD 4220  
Australia  
Phone: +61 (7) 5535 7227

### Test site inspection:

Test sites are subject to unannounced inspections by IAGI representatives. Any inspections should be noted in the Proctor Report.

### Compliance with regulations:

Failure to comply with the regulations listed in this manual and the Registered Proctor's agreement will result in the termination of Proctor privileges.

### Compensation for Proctors:

Proctors may charge a fee for administering this test. The fee is determined between the company/individual requesting this service and the Proctor. IAGI has no part in determining the fees charged. The Proctor is responsible for collecting the testing fees and submitting payment to IAGI with the order. Contact IAGI at + (720)-353-4977 or e-mail [iagi@iagi.org](mailto:iagi@iagi.org) if you have any questions.



## Wedge Welding Test Instructions

	Proctor's Instructions	Read aloud to the Test Candidate
1.	<p>Read the rules aloud to the candidates.</p> <p>Please be sure candidates allow enough time for the wedge to cool down before changing the machine setting.</p>	<p>You need to turn in three (3) samples for the hands-on portion of the wedge-weld test.</p> <p>One (1) sample must be 40 mil smooth LLDPE</p> <p>One (1) sample must be 40 mil smooth HDPE</p> <p>One (1) sample must be 60 mil textured HDPE</p> <p>Textured should be welded to textured geomembrane and smooth should be welded to smooth geomembrane.</p> <p>You are allowed to test the samples you produce using the field tensiometer.**</p> <p>You may re-weld up to three times before submitting your final sample for grading.</p> <p>For each material type, grading will be done in accordance with GM-19.</p>
2.	<p>You may not set up one welder to handle each material sample and move candidates from welder to welder.</p>	<p>You must use the same welder for all three samples. Please wait for the machine to cool down before adjusting the fusion welder for the next weld sample.</p> <p>Again, no helping other candidates with machine set-up adjustments. This is an individual test!</p>
3.	<p>Explain how to cut samples.</p>	<p>Cut a 24 inch (61 cm) long by 12 inch (30.5 cm) wide sample starting four feet from the beginning of the seam. You may take coupons for tensiometer testing from any section other than the one you submit.</p>
4.	<p>Ask candidates to mark samples.</p>	<p>Mark each sample with your name, date, material thickness and type.</p>
5.	<p>Place all finished samples into a bundle / sandbag and label it.</p>	<p>Place the three welded 12 x 24 inch (30.5 x 61 cm) samples into a bundle secured with stretch wrap or a sandbag. Label bundle or sandbag with your name.</p>
6.	<p>Gather the bundles / sandbags and pack them for shipping to the laboratory.</p>	<p>Hand the bundle / sandbag to the proctor when you are finished.</p>

**\*\*NOTE:** in some companies the welding technicians do not run the field tensiometer. It is acceptable for the quality control person to run the tests. The QC person can only report the value (number) the specimen pulled on the tensiometer. The QC person cannot indicate "pass or fail" to the candidate. It is responsibility of the test candidate to determine if the strength of the weld and / or mode of failure is acceptable for submission. The Proctor must monitor the QC personnel for compliance if this method is used. If the QC personnel states to the test candidate "pass or fail," then the weld cannot be submitted.



## Extrusion Welding Test Instructions

	Proctor's Instructions	Read aloud to the Test Candidate
1.	Read the rules aloud to the candidates.	<p>You need to turn in two (2) samples for the hands-on portion of the extrusion welding test.</p> <p>One (1) sample must be 40 mil smooth LLDPE                      One (1) sample must be 60 mil smooth HDPE</p> <p>You are allowed to test the samples you produce using the field tensiometer.**</p> <p>You may re-weld up to three times before submitting your final sample for grading.</p> <p>For each material type, grading will be done in accordance with GM-19.</p>
2.	Weld the samples	No helping other candidates with machine set-up adjustments. This is an individual test!
3.	Explain how to cut samples	Cut a 24 inch (61 cm) long by 12 inch (30.5 cm) wide sample starting four feet from the beginning of the seam. You may take coupons for tensiometer testing from any section other than the one you submit.
4.	Ask candidates to mark samples	Mark each sample with your name, date, material thickness and type.
5.	Place all finished samples into a bundle / sandbag and label it.	Place the two welded 12 x 24 inch (30.5 x 61 cm) samples into a bundle secured with stretch wrap or a sandbag. Label bundle or sandbag with your name.
6.	Gather the bundles / sandbags and pack them for shipping to the laboratory.	Hand the bundle / sandbag to the proctor when you are finished.

**\*\*NOTE:** in some companies the welding technicians do not run the field tensiometer. It is acceptable for the quality control person to run the tests. The QC person can only report the value (number) the specimen pulled on the tensiometer. The QC person cannot indicate "pass or fail" to the candidate. It is responsibility of the test candidate to determine if the strength of the weld and / or mode of failure is acceptable for submission. The Proctor must monitor the QC personnel for compliance if this method is used. If the QC personnel states to the test candidate "pass or fail," then the weld cannot be submitted.



## Order Form

1. Enter the number of exams and the total amount due:

Exam	Testing Fees (Member)	Testing Fees (Non-Member)	X	Number of tests	Total Amount Due (USD)
PE Certification Exam / Both Wedge welding and Extrusion welding hands-on	\$285	\$415	X		
PE Certification Exam / Wedge welding hands-on	\$190	\$290	X		
PE Certification Exam / Extrusion welding hands-on	\$190	\$290	X		
PE Wedge welding hands-on retake	\$95	\$125	X		
PE Extrusion welding hands-on retake	\$95	\$125	X		
TOTAL					

2. Select the language(s) needed for the written exams:

Language	Number of Exams needed
Chinese (Mandarin dialect)	
English	
French	
Indonesian	
Spanish	

3. The Proctor needs to ensure that each candidate have welding experience of at least 1,000,000 million square feet (90,000 square meters) of polyethylene geomembrane installation experience on more than five (5) different jobs. Each candidate needs to provide a resume of experience that contains contact information for the job site. The Proctor will need to turn in the resumes and copies of photo identification with the exams.



## Order Form

### 4. Expected testing date / location:

Please allow two weeks preparation and shipping time If more than 12 candidates will be testing, there will have to be another proctor present or schedule two test dates			
Date of Exam:			
Company Name:			
Address: (no PO Boxes)			
City:		Province/ State:	
Postal Code / Zip Code:		Country:	
Telephone:		Fax:	
e-mail:			

### 5. Exam shipping information (all exams must be shipped to the Proctor)

Proctor Name:			
Company Name:			
Address: (no PO Boxes)			
City:		Province/ State:	
Postal Code / Zip Code:		Country:	
Telephone:		Fax:	
e-mail:			

6. Arrange for payment. The exams can be paid by Visa or MasterCard. You may request an invoice if it is needed. Contact IAGI for wire transfer information.

7. Return Test Order Form to IAGI via fax at 612-235-6484 or e-mail [iagi@iagi.org](mailto:iagi@iagi.org).



## Proctor Report

Please fill out this report and return it to IAGI with the written tests and test registration log after the testing is completed.

<b>Proctor's Identification</b>	
Proctor's Name: _____	
Company: _____	
Address: _____	
_____	
_____	
City: _____	State/Province: _____
Zip/Postal Code: _____	Country: _____
Telephone: _____	E-mail: _____
List all other Proctors who assisted in conducting the test session. All Proctors must complete CWT training before Proctoring.	
2nd Proctor Name: _____	

Test Booklets	Quantity Received	Quantity Used	Total Un-used Tests Returned
Chinese (Mandarin dialect)			
English			
French			
Indonesian			
Spanish			



## Proctor Report

Please fill out this report and return it to IAGI with the written tests and test registration log after the testing is completed.

Item Number (if applicable)	Note all discrepancies that occurred before, during or after the test session. Also, note any discrepancies that may have occurred with this test order. List any activity or circumstance that was not part of the normal course of the entire test session or violated the testing procedures as described in the Proctor Manual.

**Company or Individual's Name and Physical Address where results are to be sent:**

Name: \_\_\_\_\_

Company: \_\_\_\_\_

Address: \_\_\_\_\_

City: \_\_\_\_\_

State/Province: \_\_\_\_\_

Zip/Postal Code: \_\_\_\_\_

Country: \_\_\_\_\_

Telephone: \_\_\_\_\_

E-mail: \_\_\_\_\_

# Test Registration Log

# IAGI Certification Program

Test Site: \_\_\_\_\_ Proctor: \_\_\_\_\_ Test Date: \_\_\_\_\_

On the day of the test, print each test candidate's name on this form as it appears on the written tests.

As each hands-on test sample is submitted, write in the mil thickness being submitted in the appropriate column across from the name of that test candidate. Write N/A in columns that don't apply as some candidates will not be testing for both fusion and extrusion welding.

Make two copies of this log when complete. Send original to IAGI with Proctor Report. Send one copy to the selected testing lab with weld samples and keep a copy for your records.

Candidates Name	Test Booklet Number	Wedge Weld LLDPE	Wedge Weld Textured HDPE	Wedge Weld Smooth HDPE	Extrusion Weld LLDPE	Extrusion Weld Smooth HDPE
		40 mil				
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						
11.						
12.						

Table 1(a) – Seam Strength and related Properties of Thermally Bonded Smooth and Textured Linear Low Density Polyethylene (LLDPE) Geomembrane (English Units)

Geomembrane Nominal Thickness	20 mils	30 mils	40 mils	50 mils	60 mils	80 mils	100 mils	120 mils
Hot Wedge Seams <sup>(1)</sup>								
shear strength <sup>(2)</sup> , lb/in.	30	45	60	75	90	120	150	180
shear elongation at break <sup>(3)</sup> , %	50	50	50	50	50	50	50	50
peel strength <sup>(2)</sup> , lb/in.	25	38	50	63	75	100	125	150
peel separation, %	25	25	25	25	25	25	25	25
Extrusion Fillet Seams <sup>(1)</sup>								
shear strength <sup>(2)</sup> , lb/in.	30	45	60	75	90	120	150	180
shear elongation at break <sup>(3)</sup> , %	50	50	50	50	50	50	50	50
peel strength <sup>(2)</sup> , lb/in.	25	34	44	57	66	88	114	136
peel separation, %	25	25	25	25	25	25	25	25

Table 1(b) – Seam Strength and related Properties of Thermally Bonded Smooth and Textured Linear Low Density Polyethylene (LLDPE) Geomembrane (S.I. Units)

Geomembrane Nominal Thickness	0.50 mm	0.75 mm	1.0 mm	1.25 mm	1.5 mm	2.0 mm	2.5 mm	3.0 mm
Hot Wedge Seams <sup>(1)</sup>								
shear strength <sup>(2)</sup> , N/25mm	131	197	263	328	394	525	657	788
shear elongation at break <sup>(3)</sup> , %	50	50	50	50	50	50	50	50
peel strength <sup>(2)</sup> , N/25mm	109	166	219	276	328	438	547	657
peel separation, %	25	25	25	25	25	25	25	25
Extrusion Fillet Seams <sup>(1)</sup>								
shear strength <sup>(2)</sup> , N/25mm	131	197	263	328	394	525	657	788
shear elongation at break <sup>(3)</sup> , %	50	50	50	50	50	50	50	50
peel strength <sup>(2)</sup> , N/25mm	95	150	190	250	290	385	500	595
peel separation, %	25	25	25	25	25	25	25	25

Notes for Tables 1(a) and 1(b):

1. Also for hot air and ultrasonic seaming methods
2. Value listed for shear and peel strength are for 4 out of 5 test specimens; the 5<sup>th</sup> specimen can be low as 80% of the listed values
3. Elongation measurements should be omitted for field testing

Table 2(a) – Seam Strength and related Properties of Thermally Bonded Smooth and Textured High Density Polyethylene (HDPE) Geomembrane (English Units)

Geomembrane Nominal Thickness	30 mils	40 mils	50 mils	60 mils	80 mils	100 mils	120 mils
Hot Wedge Seams <sup>(1)</sup> shear strength <sup>(2)</sup> , lb/in. shear elongation at break <sup>(3)</sup> , % peel strength <sup>(2)</sup> , lb/in. peel separation, %	57 50	80 50	100 50	120 50	160 50	200 50	240 50
	45 25	60 25	76 25	91 25	121 25	151 25	181 25
	57 50	80 50	100 50	120 50	160 50	200 50	240 50
	39 25	52 25	65 25	78 25	104 25	130 25	156 25
Extrusion Fillet Seams <sup>(1)</sup> shear strength <sup>(2)</sup> , lb/in. shear elongation at break <sup>(3)</sup> , % peel strength <sup>(2)</sup> , lb/in. peel separation, %	57 50	80 50	100 50	120 50	160 50	200 50	240 50
	45 25	60 25	76 25	91 25	121 25	151 25	181 25
	57 50	80 50	100 50	120 50	160 50	200 50	240 50
	39 25	52 25	65 25	78 25	104 25	130 25	156 25

Table 2(b) – Seam Strength and related Properties of Thermally Bonded Smooth and Textured High Density Polyethylene (HDPE) Geomembrane (S.I. Units)

Geomembrane Nominal Thickness	0.75 mm	1.0 mm	1.25 mm	1.5 mm	2.0 mm	2.5 mm	3.0 mm
Hot Wedge Seams <sup>(1)</sup> shear strength <sup>(2)</sup> , N/25mm shear elongation at break <sup>(3)</sup> , % peel strength <sup>(2)</sup> , N/25mm peel separation, %	250 50	350 50	438 50	525 50	701 50	876 50	1050 50
	197 25	263 25	333 25	398 25	530 25	661 25	793 25
	250 50	350 50	438 50	525 50	701 50	876 50	1050 50
	170 25	225 25	285 25	340 25	455 25	570 25	680 25
Extrusion Fillet Seams <sup>(1)</sup> shear strength <sup>(2)</sup> , N/25mm shear elongation at break <sup>(3)</sup> , % peel strength <sup>(2)</sup> , N/25mm peel separation, %	250 50	350 50	438 50	525 50	701 50	876 50	1050 50
	197 25	263 25	333 25	398 25	530 25	661 25	793 25
	250 50	350 50	438 50	525 50	701 50	876 50	1050 50
	170 25	225 25	285 25	340 25	455 25	570 25	680 25

Notes for Tables 1(a) and 1(b):

- Also for hot air and ultrasonic seaming methods
- Value listed for shear and peel strength are for 4 out of 5 test specimens; the 5<sup>th</sup> specimen can be low as 80% of the listed values
- Elongation measurements should be omitted for field testing