Geo-Synthetics, Inc.

Waukesha, WI

Installation Services

Statement of Qualifications

2011

Tel: 800 444-5523

Fax: 262 524-7961

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Geo-Synthetics LLC
2401 Pewaukee Road Waukesha, WI 53188
www.geo-synthetics.com

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***Key projects listing available on request via fax or e-mail.**

1.0 Introduction

Geo-Synthetics, Inc. (GSI) is one of the nations largest independent installers of geosynthetic materials. As an independent installer, GSI has the ability to source specification compliant materials from select leading manufacturers. GSI has established solid working relationships with the industry's leading suppliers and has positioned itself to be able to procure the most technically advanced geosynthetic materials currently available. Our 25 years + installation experience, refined installation techniques and materials purchasing expertise combine to offer our clients unmatched geosynthetic product solutions on a supplied and installed basis. Project references include successfully completed projects in all of the following areas of geosynthetic application:

* Landfill Closures
* Solid Waste Landfills
* Secondary Containment
* Waste Water Containment
* Industrial Lagoons
* Decorative Ponds
* Methane Barriers

GSI is a well known and well respected installer of geosynthetics. We are involved in numerous industry associations including IAGI (the International Association of Geosynthetics Installers), in which we are instrumental in developing industry accepted specifications, including the IAGI HDPE Geomembrane Installation Specification (for high density polyethylene geomembrane liners).

GSI's client list has traditionally included general contracting firms, engineering companies, private owners and government agencies at all levels, located coast to coast in the United States operating in a wide range of industries. We have provided installation services in all of the following market areas:

* Waste Management
* Power and Energy
* Civil Construction
* Pulp and Paper
* Oil and Gas
* Aquaculture
* Agriculture
* Mining

We are confident that upon review of this document, you will feel assured of the geosynthetic construction service capabilities of GSI.

2.0 Installation Services

GSI's estimating, project management and construction operations are based in Waukesha, Wisconsin. Individual installation crews operate from locations across the country enabling GSI to provide competitive local service to markets coast to coast. As shown in our enclosed projects reference list, GSI can demonstrate installation experience coast to coast within the United States, working for private and public owners, general contractors and engineering firms.

GSI has the ability to procure and supply to site all required geosynthetic materials and to furnish all required site supervision, skilled technicians, in-house quality control technicians, site labor, deployment equipment and equipment operators, etc., related to the installation of the geosynthetic materials. Generally speaking our primary requirements of an owner or general contractor are to unload a portion of the materials prior to our mobilization to site and to provide the prepared subgrade and related earthworks on site. Scopes of work will of course vary from project to project depending on the nature of the job, resources of the owner or general contractor and site labor conditions, etc. Our basic scope of work generally provides for the following:

* Transportation of materials to site
* Unloading (once GSI fully mobilized)
* Deployment of all geosynthetic materials
* Seaming (e.g. fusion and extrusion welding, etc.)
* Quality control (per GSI in-house guidelines)

GSI has extensive installation experience with a full range of geosynthetic materials:

* HDPE and VFPE Geomembrane Liners
* PVC and Polypropylene Geomembrane Liners
* Hypalon and XR-5 Geomembrane Liners
* Geonets and Geocomposite Drainage Products
* Geotextiles (Woven and Nonwoven)
* Geosynthetic Clay Liners (GCL's)
* Erosion Control Materials
* Paving Grade Materials

Our geomembrane lining installation experience with HDPE, VFPE, PVC, Polypropylene, Hypalon and XR-5 liners now exceeds over 100,000,000 square feet gathered on literally hundreds of projects over the past 25 years.

3.0 Project Development

3.1 Sales Coverage and Sales Services

GSI is somewhat unique in its approach to sales as an independent installation company in that it maintains a highly proactive regionally based sales force charged with the responsibility of seeking out and developing new sales opportunities. Although the skills set of each individual varies our basic approach to sales is to provide technical knowledge and assistance to the owner, designer, specifying engineer or contractor as required at either the permitting, design, specification, bid or construction phase of a project's development. We wish to position ourselves to be primarily known as the recognized resource for geosynthetic installation solutions for more challenging projects where our expertise is best utilized.

In addition to fulfilling our clients Requests for Proposal (RFP's) or Requests for Quote (RFQ's), our Regional Sales Managers are capable of assisting with all of the following:

* Materials Selection
* Materials Specification
* Specification Review
* Budgetary Pricing
* Design Details
* Scheduling
* Submittals
* Credit

Responding to the need for a single point of contact for larger national scale accounts, GSI has recently created the position of National Accounts Development Manager for this purpose.

GSI's sales management is based in Waukesha, Wisconsin with Regional Sales Managers reporting to the President. Regional sales coverage operates from Waukesha as well as other locations based in South Dakota, and Texas. National Accounts sales coverage is based in Waukesha.

Sales within the construction services group at GSI exceed $30,000,000 annually.

3.2 Estimating

Estimating at GSI is a stand-alone function within the construction services group with the Chief Estimator reporting to the Construction Manager. Based in Waukesha, Wisconsin, the estimating group at GSI is capable of performing take-off estimates on hundreds of projects annually (GSI consistently estimates over 400 projects annually with a total bid value in excess of $100,000,000 per year).

GSI has developed its own “home grown” estimating package in an MS Excel spreadsheet format. The package allows for a large degree of flexibility in terms of respective scopes of work for GSI as well as the earth works contractor. AutoCad R14 software is used for all drafting and quantity estimating requirements. All project estimates involve the generation of a preliminary panel layout drawing and bar chart schedule detailing expected work days for project completion. Proposals are generated by the estimating department and may be communicated by e-mail if requested.

3.3 Contracts

All contracts require review by the Construction Manager and the review and signature of the President of the Company. Key items within any GSI construction services contract will necessarily include well defined scopes of work consistent with GSI’s proposal, clearly established methodology of payment, payment terms, insurance, bonding and warranty expectations.

GSI site Superintendents are authorized to accept signed change orders although back-charges to GSI must be authorized by the Construction Manager or the President in order to be duly accepted.

3.4 Procurement

Procurement of materials with associated manufacturing and shipment to site requires the establishment of an acceptable line of credit and formation of a signed contract (or accepted materials purchase order) with GSI. Purchase orders to GSI vendor firms are generally only issued by GSI when a signed contract comes into effect. Generally speaking within the geosynthetics industry vendor pricing is guaranteed for only relatively brief periods of time due to the susceptibility of geosynthetic materials to resin price fluctuations (most geosynthetics are made from polyethylene or polypropylene resins, etc.). On rare occasions Letters of Intent may be used to secure vendor pricing.

3.5 Project Management

Reporting directly to the President of the Company, the Construction Manager, based in Waukesha, Wisconsin, has overall responsibility for all geomembrane related installation activities conducted by GSI.

Project Managers reporting to the Construction Manager, are responsible for the scheduling of individual projects including the coordination of material deliveries to site and timely mobilization to site of GSI installation personnel. Achievement of project milestone dates is also the responsibility of the GSI Project Manager. These individuals possess extensive practical field experience and training in project management techniques.

GSI field crews are generally comprised of a single site Superintendent, GSI trained full time welding technicians (at least one of which is qualified to operate site deployment equipment if necessary), a quality control technician (reporting to the Project Manager) and site laborers hired locally if necessary depending on the nature of the project and materials to be installed. The site Superintendent has responsibility for day to day activities on site including coordination of activity with the earthworks contractor, third party inspection firm and safety as it relates to GSI personnel on site. GSI is active on 80 to 100 projects annually across the United States.

3.6 Safety

No work or service rendered by GSI employees shall become so important as to assume priority over the safety of an employee. All GSI site Superintendents and lead technicians are OSHA trained and certified. The site Superintendent generally has the responsibility for day to day safety activities on site.

GSI has a written Safety Manual for field activities relating to geomembrane liner installation. The Manual, copies available upon request, provides guidelines not limited to all of the following:

1. Deliveries
   - unloading vehicles
   - fueling
   - lifting and carrying
   - lighting
   - loading
   - tie downs

2. Field Activities
   - vehicle safety
   - deployment

- electrical safety

3.6 Safety (continued)

- eye protection
- fire protection
- flammable and combustible materials
- forklift and loader safety
- head protection
- heat exhaustion
- lifting and carrying
- personal protective equipment (PPE)
- tool safety

3. General Vehicle Safety
   - fueling
   - lights
   - seat belts
   - severe weather
   - tires
   - transporting employees
   - wipers

4. Record Keeping
   - accident reporting
   - accident investigation
   - OSHA 300 Log
   - disciplinary action

The following summarizes GSI response to key items common to typical contractor safety questionnaires:

*	Do you certify that all individuals assigned to the project will be drug and alcohol free?	Yes
*	Do you certify that all individuals assigned to the project will be fit for respiratory duty, if applicable?	Yes
*	Do you certify that all individuals assigned to the project will be fit to safely perform the required tasks?	Yes
*	Does your safety and health representative visit each site prior to the beginning of each project?	Yes
*	Do job descriptions for supervisory staff and management include safety and health responsibilities?	Yes
*	Does your organization have a program for reward and recognition of outstanding safety performance?	Yes

3.6 Safety (continued)

*	Does your organization have a disciplinary system for unacceptable safety performance?	Yes
*	Are workers encouraged to intervene when they observe a co-worker performing at risk?	Yes
*	Are the safety and health hazards associated with job activities / tasks identified before they begin?	Yes
*	Does your organization have a medical and first aid program?	Yes
*	Does your organization have a substance abuse program?	Yes
*	Are new employees trained in their craft prior to job placement?	Yes
*	Are new employees given a company specific safety orientation?	Yes
*	Do you provide CPR or First Aid training for your personnel?	Yes
*	Do you maintain a record of all training provided to all employees?	Yes

GSI is working diligently to continuously improve its safety programs and safety record, with the objective of becoming exemplary in our industry within the field of safety.

GSI has established site specific safety programs with a view towards zero recordable incidents on any one specific project, including assignment of site specific safety officers if required (the GSI site Superintendent is generally responsible for all day to day safety activities on site).

Documentation available upon request.

4.0 Key Personnel

President – Robert F. Groh

Bob Groh is President and majority shareholder of Geo-Synthetics, Inc. Bob has been involved with GSI since it's beginning, with the Company being founded by Bob's father in 1971. Since that time, GSI has grown from a local installer of paving grade geotextiles to a nationally recognized distributor of a full range of geosynthetics. Bob was instrumental in GSI's expansion into the geosynthetics distribution business with geomembrane installation capabilities added in 1986. He has overall responsibility for all sales and construction activities of the Company and active involvement in corporate strategic planning and corporate acquisitions. Bob has a degree in political science from UW – Whitewater.

Construction Manager – Dave Schuster

Dave is a professional engineer with over 25 years experience in complex highway, airport and waterway construction projects. He has been involved in all aspects including field supervision, estimating, project management, and executive management. Dave has a degree in Civil Engineering from Marquette University - Milwaukee, WI.

V.P. Distribution Sales / Marketing – Scott Nelson

Scott Nelson is Vice President Distribution Sales/Marketing and a minority shareholder of Geo-Synthetics, Inc. Scott has been involved in the civil engineering construction industry for 30 years, initially in the trades with the last 21 years in sales. He has been involved in all aspects of sales and sales management both in distribution and manufacturing, with a heavy emphasis in geosynthetics and erosion control products. Scott is also involved in numerous national organizations.

5.0 Financial Strength

GSI is a financially strong, profitable company. Geo-Synthetics, Inc. is headquartered in Waukesha, Wisconsin.

GSI would be pleased to provide a Financial Statement upon request.

6.0 Insurance

GSI is a capably insured company. Typically, insurance will include General Liability Coverage for personal injury and property damage in the amount of $2,000,000 and Worker's Compensation coverage in the amount required by law. General Liability insurance is on an Occurrence Basis. Umbrella Coverage up to $8,000,000 is available.

We would be pleased to provide a sample Certificate of Insurance upon request.

7.0 Bonding & Warranties

GSI has a high capacity for bonding as evidenced by the size of projects listed herein. Performance bonding can typically be provided at an additional cost based on contract value. Warranty bonds for materials can sometimes be arranged in consultation with GSI's supplying manufacturers. Warranty bonds for installation work performed by GSI can also be arranged at additional cost if requested.

Warranties are always issued on a project specific basis. Warranties on materials will be per the warranty terms offered by GSI's supplying manufacturers (typically five years on geomembrane materials). Warranties on installation will be consistent with industry norms, likely for one or two years depending on the nature of the project. All warranties offered on a prorated basis.

8.0 Quality Control

GSI has developed its own in-house Field Quality Control Manual with the intention of offering a consistently high standard of workmanship to our clientele. The Manual, (see reference document section), provides guidelines related to all aspects of geosynthetics installation not limited to the following:

1. Material delivery
   - verification of equipment capabilities
   - identification of any damaged materials
   - verification of adequate storage provisions
   - ensure that materials are properly identified and that labeling matches manufacturers quality control documentation and shipping bills of lading

2. Geomembrane installation
   - handling and placement
   - subgrade requirements and preparation
   - anchor trench requirements
   - panel layout preparation
   - field panel placement
   - field seaming (personnel & equipment)
   - weather conditions
   - seaming
   - seam preparation
   - trial welds
   - seam sampling
   - seam testing (destructive & non-destructive)
   - defect and repair procedures

3. Geotextile installation
   - handling and placement
   - seams and overlaps
   - repairs

4. Geonets & Geocomposite installation
   - handling and placement
   - seams and overlaps
   - repairs

5. Geosynthetic Clay Liner (GCL) installation
   - handling and placement
   - seams and overlaps
   - repairs

GSI installation guidelines are consistent with industry-accepted practice and conform to most recognized industry specifications (e.g. IAGI)

QUALITY CONTROL TECHNICIAN FIELD MANUAL

March 2011

Geo-Synthetics LLC.
2401 Pewaukee Road Waukesha, WI 53188
www.geo-synthetics.com

Introduction

Quality control work is one of the most important requirements of our profession. Your work is not only reviewed by GSI QC Staff, but is used by project owners, engineers and state regulatory agencies. It is of utmost importance that that your work be completed timely and accurately.

This manual is to be used as a guide for the most common situations you will encounter in the field, however it will not cover every situation. If you follow the guidelines laid out in this manual you should be able to work through any situation you encounter. If you have any questions, please contact the office.

Preparation

As with all things in life, the amount of preparation you put into a project has a direct effect on the success of that project. Preparation for geosynthetic installation falls into two categories: Pre-Project Preparation and Daily Preparation.

Pre-Project Preparation

The key to pre-project preparation is reading the project specifications and/or site quality control/quality assurance manuals. This should be done prior to arriving at a site. A good time to do this is while you are traveling between projects. As you read more specifications and QC manuals you will see that there are basically two types, ones that are written well and those that are written poorly. Well written specifications make it easier to obtain the information you need to do your job. The ones that are written poorly will require more of your attention to obtain the same information.

Well written specifications are generally broken up into three or four sections. These sections include:

- General Information such as project description, definitions, lines of authority, submittals, ect.
- Products/Materials
- Execution
- Closeout Requirements (optional).

Though you should read the entire specification, most of your efforts should be spent on the execution portion of the specification.

There are several items that you should pay extreme attention to. These items include:

- Can you use vehicles on the liner?
- What are the requirements for fueling generators and rub sheets?
- How far out from the slope do panels need to extend?
- Are horizontal seams acceptable and when are they acceptable?
- How often are Trial Seams needed?
- How many test coupons are needed for Trial Seams?
- What are the passing values for Trail Seams?
- What are the Non-Destructive Test requirements?
- How often are Destructive Samples to be taken?
- Who marks out the Destructive Samples and who sends them to the lab?
- How many test coupons are needed for field testing Destructive samples?
- What amount of peel separation is acceptable?
- How are repairs to be handled?
- Any other information relevant to geosynthetics installation. If the project has multiple layers read all of the specification sections provided. This is important because some projects require QC data on all of the layers.

As you are reading the specifications, note these items and any thing that you feel is important. Prior to starting a project, talk to your superintendent about the specifications and make sure the other technicians are aware of what is required of them.

Daily Preparation

Prior to going out in the field ask yourself, do I have everything that I need? It's amazing how many times equipment needed to do your job is left at the trailer, the truck, or at the hotel. Keep in mind that the following items are needed on a daily basis:

- Hard Hat
- Safety Vest
- Safety glasses
- Something to write on
- Something to write with; (pen, or pencil), Pencils are preferred because they do not smear or run out of ink, they can be used out of position, it is easier to correct mistakes, and they can also be used for drafting
- Eraser
- Drafting supplies (Record Drawing section has details on drafting supplies)
- Markers
- Paint
- Measuring wheel
- Scientific Calculator with square root function
- Scale
- Field forms

Carry the amount of field forms you will need for that work period. Do not carry too few as to run out or too many as to have an excessive amount of paper with you (that may sound contra productive, but with experience you will know the amount of paper work that you need). After lunch, ask do I need more supplies before heading back out.

Remember, your field work time is the same as everyone else. When your crew is in the field, you are expected to be in the field. When your crew leaves for the day, you are expected to have your work complete and be prepared to leave the field with them.

In conclusion, preparation prior to and throughout the project is vital to the success of the project. Please prepare accordingly.

Field Work

Data Collection

Collecting field data is the most fundamental part of your job. It is to be collected timely and accurately. There are eight Field Forms used by GSI. These forms include:

- Material Inventory Form;
- Subgrade Acceptance Form;
- Panel Placement Form;
- Trial Weld Form;
- Panel Seaming Form;
- Non-Destructive Testing Form;
- Destructive Test Form: and,
- Repair Form.

These forms are not to be altered in any way or on a project by project basis. If you feel your job needs to have something added to the form, you must contact the office first.

During most jobs, you may be working with a third party inspector. Try to build good relations with the inspector. Collaborate with the inspector when necessary. However, **You Are To Do Your Own Field Work**. You are not to rely on the inspector's information only. Collect your own field data.

HELPFUL HINTS:

Some specifications ask that you turn in a copy of your field data to the third party Engineer on a daily basis. Give the third party a copy of your information, not your original information and ask that they return it to you with any comments within the same time period that you had to provide it to them. This will allow you to correct any mistakes there may be while still on site.

Forms

Inventory Form

Parts of the Form:

GSI
MATERIAL INVENTORY FORM

Page __F__ of ___

PROJECT NAME:	A	DATE:	D
PROJECT NO.:	B	Q.C. NAME:	E
MATERIAL TYPE:	C		

ROLL NUMBER	PANEL/ROLL SIZE	SQUARE FOOT	COMMENTS
G	H	I	J

Inventory rev 4
March 2010

A Project Name – This is the project name given by the office. Do not makeup your own name. For example, Ameren Duck Creek is Ameren Duck Creek NOT Canton IL.

B Project Number – Assigned by the office. Do not makeup a number.

C Material Type – Examples 60 mil HD, 40 mil LLDPE, Composite (Include Material Type, Thickness, and Texturing)

D Date

E Name – Your Name

F Page Number

G Roll Number – Manufactures Roll Number found on the core or outer wrapping

H Panel Roll Size – The dimension of the roll or panel. Example: A 60 mil GSE Textured HDPE roll is 22’ x 520.

I Square Foot – The multiplication of the dimension. That is 22 x 520 = 11440 sf.

J Comments - Any additional information.

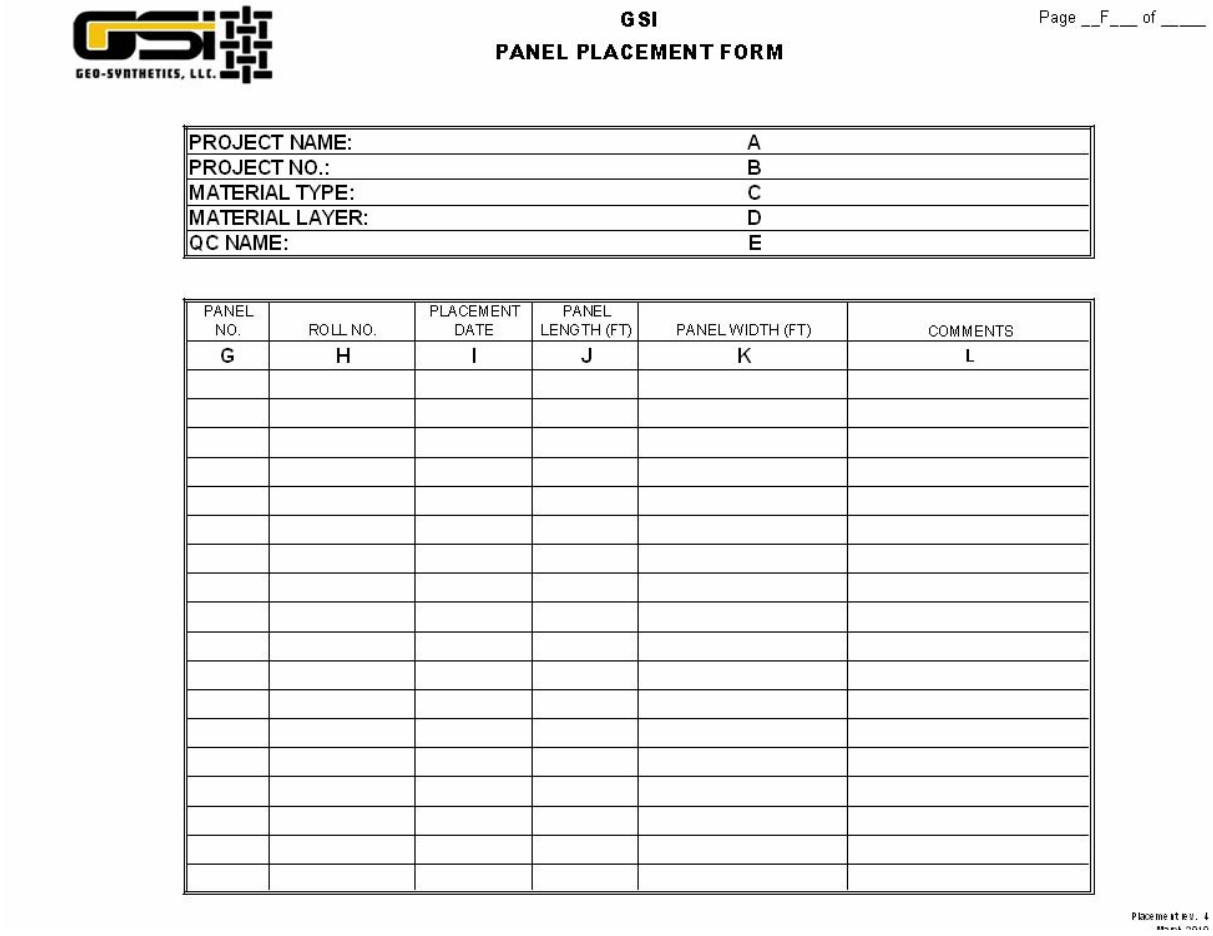
Filling Out the Form

1 Inventory Forms are to be filled out at the **BEGINNING** and **END** of the project.

2 File Completed Paperwork in a Completed Paperwork File.

Panel Placement Form

Parts of the Form:



GSI

PANEL PLACEMENT FORM

Page __F___ of ____

PROJECT NAME:	A
PROJECT NO.:	B
MATERIAL TYPE:	C
MATERIAL LAYER:	D
QC NAME:	E

PANEL NO.	ROLL NO.	PLACEMENT DATE	PANEL LENGTH (FT)	PANEL WIDTH (FT)	COMMENTS
G	H	I	J	K	L

A Project Name – This is the project name given by the office. Do not makeup your own name. For example, Ameren Duck Creek is Ameren Duck Creek NOT Canton IL.

B Project Number – Assigned by the office. Do not makeup a number.

C Material Type – Examples 60 mil HD, 40 mil LLDPE, Composite (Include Material Type, Thickness, and Texturing)

D Material Layer – Examples: Primary, Secondary, Rain Flap, Sacrificial ect.

E Name – Your Name.

F Page Number.

G Panel Number.

H Roll Number.

I Placement Date.

J Panel Length.

K Panel Width.

L Comments - Any additional information.

Filling Out the Form

1 Start a NEW FORM DAILY.
2 Page Number Starts at 1 EACH DAY.
3 A Panel Must Have an Approximate Dimension of at Least Half a Roll Width in Both Directions (~11 feet x 11' feet). If Less Than Half a Roll Width, Call it a Cap or an Extension and Log it on the Repair Form.
4 Remember a Panel may be a full roll or a portion of a roll. If the full roll is not used make sure the remaining partial is marked with the ROLL NUMBER.
5 If the project you are on has multiple layers (such as a primary and secondary liner) start panel numbers S-001 for secondary and P-001 for Primary Liners.
6 If the project you are on has multiple cells or ponds (for example Pond 1, Pond 2 and Pond 3) Start panel numbers at P-1001 for pond 1, P-2001 for Pond 2, and P-3001 for Pond 3, or 1P-001 for Pond 1, 2P-001 for Pond 2, and 3P-001 for Pond 3.
7 Keep in mind that place panels can be cut and the cut section may be scrapped or used in another location such as a corner. You must account for those cut sections.
8 Unless a panel is cut, the width will not change.
9 The area of a square or rectangle is width x length.
10 The Area of a right triangle is ½ width x length.
11 Most odd shaped panels can be reduced to a series of rectangles (squares) or right triangles.
12 Measure odd shape panels through the center of the panel and not the edges.
13 File Completed Paperwork in a Completed Paperwork File.

HELPFUL HINTS:

When installing multiple layer systems, use different colored field forms for each area. For example, log secondary data on a white form and primary data on a blue form.

Trial Weld Form

Parts of the Form

GSI
TRIAL WELD FORM

Page _F__ of ___

PROJECT NAME:	A	Test Criteria	Fusion G mil	Extrusion mil
PROJECT NO.:	B	Time	H	
MATERIAL TYPE:	C	Number	I	
MATERIAL LAYER	D	ppi - Peel	K	
QC NAME:	E	ppi - Shear	L	

Date M

Trial No.	Sample Time	Air Temp	Mater Type	Tech Initials	Machn No.	Wedge Barrel	Speed Preheat	Peel (ppi) 1		2		3		4		5		Shear (ppi) 1	2	3	4	5	Pass Fail
No.	O	P	Q	R	S	T	U	V	V	V	V	V	V	V	V	V	V	W	W	W	W	W	X

*S/S = SMOOTH/SMOOTH; S/T = SMOOTH/TEXTURED; T/T = TEXTURED/TEXTURED

Trial rev. 4 March 2010

A Project Name – This is the project name given by the office. Do not makeup your own name. For example, Ameren Duck Creek is Ameren Duck Creek NOT Canton IL.

B Project Number – Assigned by the office. Do not makeup a number.

C Material Type – Examples 60 mil HD, 40 mil LLDPE, Composite (Include Material Type, Thickness, and Texturing)

D Material Layer – Examples: Primary, Secondary, Rain Flap, Sacrificial ect.

E Name – Your Name.

F Page Number. Start a New Page Daily.

G Material Thickness: (40, 60, 80, 100 mil)

H Every __ Hrs. – How long between Trial Seams (example Every 4 Hrs.). This needs to be obtained form the **PROJECT SPECIFICATIONS**.

I Number – The number of samples (example 3p/2s would be 3 peels and 2 shears). Obtained form the **PROJECT SPECIFICATIONS**.

J PPI–Peel – Passing Peel Values for Fusion. Obtained form the **PROJECT SPECIFICATIONS**.

K PPI–Peel – Passing Peel Values for Extrusion. Obtained form the **PROJECT SPECIFICATIONS**.

L PPI-Shear - Passing Shear Values for Fusion and Extrusion. Obtained form the **PROJECT SPECIFICATIONS**.

M Trial Seam Date – Date of Trial seam.

N Trial seam No. – Filled Out During Nightly Check. See Next Section Reviewing Data.

O Time of Trial seam

P Air Temperature

Q Material Type (S/S, S/T, or T/T)

R Technician Initials

S Welder Type – Include welder type and weld machine number (example F-82 or W-82 is Fusion Welder or Wedge 82, E-75 or X-75 is extrusion Welder 75).

T Wedge/Barrel – Wedge or Barrel Temperatures.

U Speed/Preheat – Wedge Speed or preheat Temperature.

V Peel (ppi) – Test Values

W Shear (ppi) – Test Values.

X Pass/Fail – P or F.

Filling Out the Form

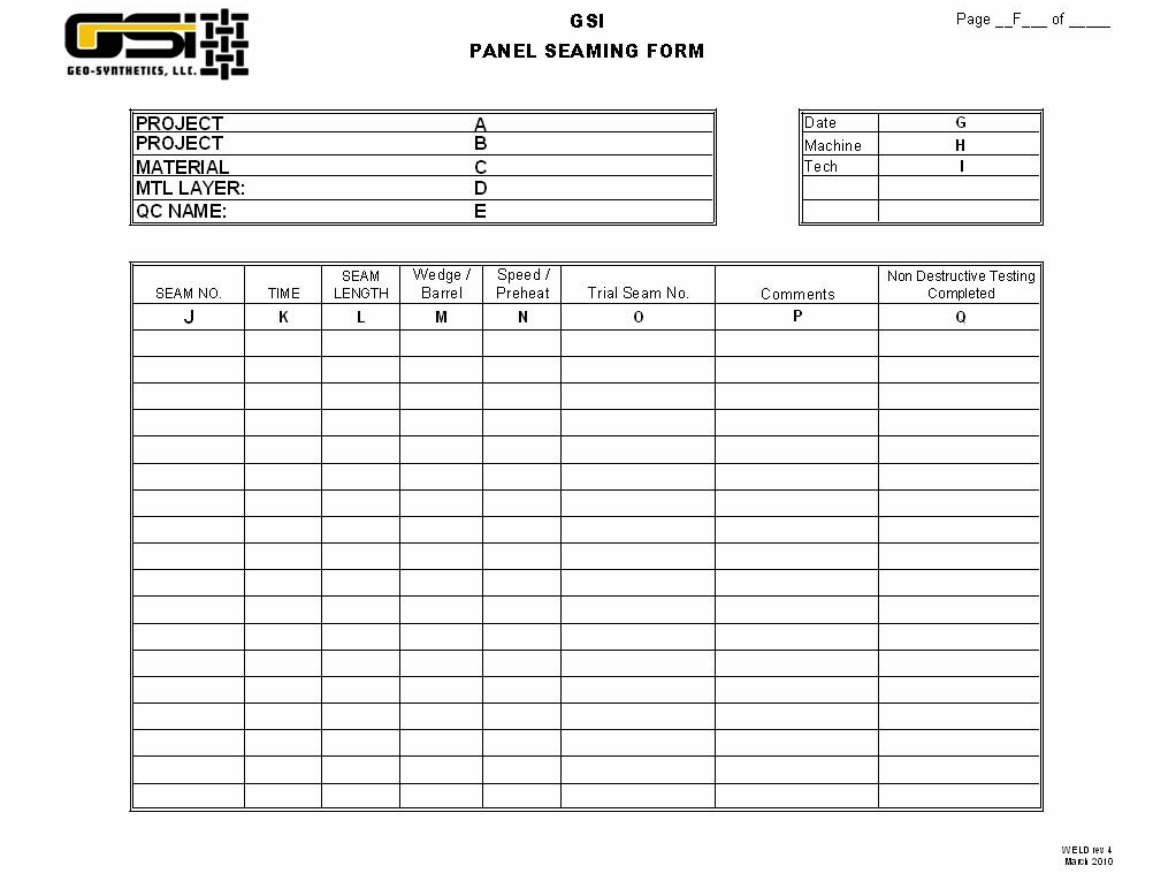
1. Have the technicians test their own trial seams whenever possible. Explain to the technicians in a morning meeting that they need a trial seam every X-Hours, X-number of peels, X-number of shears, the values required to pass the test, and that any incursion into the weld is a failure. Explain that a failed trial seams is not a “Big Thing”. A failed Destructive Test is a “Big Thing”. The Trial Seam is to make sure equipment is running right.
2. **KNOW YOUR SPECIFICATION**. Each specification deals with failed trial seams differently. Some specifications will require a retest until a passing test is obtained. Other specifications may require two consecutive passing trial seams for each failure. So once again: KNOW YOUR SPECIFICATION.
3. Collect Trial Seam Form at the end of every day
4. Place a new Trial Seam Form at the tensiometer every morning.
5. Start each day with Page 1.
6. Start each day with Trial Seam number one.
7. File Completed Paperwork In a Completed Paperwork File.

8 If a multilayer system is being installed (primary and secondary liners), keep trial seam separated by layer. Trial seams for the primary layer should be on separate forms from trial seams for the secondary layer.

HELPFUL HINTS:

Use Military Time when filling out the forms, this avoids the need to include am/pm and possible confusion from such. Midnight 12:00 am is 0000, Noon 12:00 pm is 1200, 7:00 am is 0700, 5:00 pm is 1700.

Panel Seaming Form
Parts of the Form



GSI
PANEL SEAMING FORM

Page __F___ of _____

PROJECT	A
PROJECT	B
MATERIAL	C
MTL LAYER:	D
QC NAME:	E

Date	G
Machine	H
Tech	I

SEAM NO.	TIME	SEAM LENGTH	Wedge / Barrel	Speed / Preheat	Trial Seam No.	Comments	Non Destructive Testing Completed
J	K	L	M	N	O	P	Q

WELD rev 4
March 2010

A Project Name – This is the project name given by the office. Do not makeup your own name. For example, Ameren Duck Creek is Ameren Duck Creek NOT Canton IL.

B Project Number – Assigned by the office. Do not makeup a number.

C Material Type – Examples 60 mil HD, 40 mil LLDPE, Composite

D Material Layer – Examples: Primary, Secondary, Rain Flap, Sacrificial ect.

E QC Name – Your Name.

F Page Number.

G Date – Day Seam was Welded.

H Machine Number – Include welder type (example F-82) and should match Trial seam Form.

I Tech – Technician who welded the seams initials. Should Match Trial Seam Form

J Seam No – A seam Number is a combination of two welded panels. For example, Panel P-001 welded to P-002 would be seam P-001/002. Panel P-006 Welded to Panel P-165 would be P-006/165. Always list smaller number first.

K Time – Time Welder started the seam.

L Seam Length (may be longer than panel if panel is odd shaped and measured in the middle).

M Wedge/Barrel – Wedge or Barrel Temperatures (may be slightly different from Trial Seam Form).

N Speed/Preheat – Fusion Machine Speed or Extrusion Welder Preheat (may be slightly different from Trial Seam Form).

O Trial seam No – Filled Out During Nightly Check. See Next Section Reviewing Data.

P Comments – any addition information.

Q Non Destructive Testing Completed - Filled Out During Nightly Check. See Next Section Reviewing Data.

Filling Out the Form

1 A seam Number is a combination of two welded panels. For example, Panel P-001 welded to P-002 would be seam P-001/002. Panel P-006 Welded to Panel P-165 would be P-006/165.

If welding a combination of seams or a tie-in, **COMBINING SEAMS IS NOT ACCEPTABLE. EACH SEAM MUST BE LOGGED INDIVIDUALLY!** For example; if floor Panel P-001 is going to be welded to slope panels P-014, P-015, P-016, P-017, P-018, **DO NOT** log as P-001/1014-018. Each seam segment must be logged individually as P-001/014; P-001/015; P-001/016; P-001/017; and P-001/018.

2 Do not file form with completed paper work until all areas have been filled out.

3 When Multiple Layers are being installed, start secondary panels with an S-prefix (S-001/002) and Primary panels with a P-prefix (P-001/002).

4 If doing multiple cells or ponds, Start panels with prefix and pond number (Pond 1 P-1001/002, Pond 2 P-001/002, Pond 3 P-3001/002).

5 Keep up with logging as welding happens.

6 Use separate forms for each welder.

7 Start new forms Daily and Start Page Numbers at 1 each day.

8 If two panels have never been welded before (including a tie-in to an existing liner), then the seam needs to be recorded on a Seaming Form. This includes extrusion welds. Do not log these seams as repairs because they are not repairs they are seams.

9 If a seam has been welded before, then it is a repair and needs to be on the Repair Form.

10 **ALWAYS LOG THE LOWER PANEL NUMBER FIRST.** P-002/001 is incorrect. This should be P-001/002. Look to see what is around you, take a deep breath and log it right.

11 Occasionally a repair will need to be logged on a seaming log. This generally happens for a fusion repair. Remember to log the Panel first and then the REPAIR NUMBER. For example Seam P-001/002 need a 15 foot cap (repair number R-15). This would be logged as P-001/R-15. Don't Forget to log the other side, P-002/R-15.

12 At a three or four panel intersection that you know will be capped or patched the seam between the panels does not have to be logged. If you do log the seam you will need to identify the repair in the comments section by Repair Number.

HELPFUL HINTS:

Keep each welder on his or her own set of seaming forms. This will make it easier to check against the other forms. Also, if a failed Destructive Tests needs to be tracked this will make that process easier.

Non-Destructive Testing Form

Parts of the Form

GSI
NON-DESTRUCTIVE TESTING FORM

Page __F___ of ____

PROJECT NAME:	A	Test Criteria	AIR TEST	Test Criteria	Vacuum Test
PROJECT NO.:	B	Start Pressure	G	Vac. Time	J
MATERIAL TYPE:	C	Test Time	H	Vac. Pres.	K
MATERIAL LAYER:	D	Accept. Drop	I		
QC NAME:	E				

Seam Number	Test Date	Tech Initials	Test Type (A or V)	Air Pressure Test		Time		Test Result (P or F)	Test Locations
				psi start	psi finish	Start	End		
L	M	N	O	P	Q	R	S	T	U

Non-D rev 4
March 2010

A Project Name – This is the project name given by the office. Do not makeup your own name. For example, Ameren Duck Creek is Ameren Duck Creek NOT Canton IL.

B Project Number – Assigned by the office. Do not makeup a number.

C Material Type – Examples 60 mil HD, 40 mil LLDPE, Composite

D Material Layer – Examples: Primary, Secondary, Rain Flap, Sacrificial ect.

E Name – Your Name.

F Page Number.

G Start Pressure – Obtained from the project specifications.

H Test Time – Test duration obtained from the project specifications.

I Acceptable Drop – Allowable pressure drop obtained from the project specifications.

J Vac. Time – Vacuum Test Time obtained from the project specifications.

K Vac. Pres – Vacuum Test Pressure obtained from the project specifications.

L Seam Number – Seam being tested.

M Test Date – Date Test was performed.

N Tech Initials – The person who performed the test.

O Test Type A or V – A for Air Test, V for Vacuum Test, AL for Air Lance, S for a spark test.

P Pressure Start – Test Start Pressure.

Q Pressure Finish – Test End Pressure.

R Time Start.

S Time End.

T Test Result – P=pass, F=Fail.

U Test Location – Test Segment.

Filling Out the Form

1 A Seam Number is a combination of two welded panes. For example, Panel P-001 welded to P-002 would be seam P-001/002. Panel P-006 Welded to Panel P-165 would be P-006/165.

If testing a combination of seams or a tie-in, **COMBINING SEAMS IS NOT ACCEPTABLE. EACH SEAM MUST BE LOGGED INDIVIDUALLY!** For example; if floor Panel P-001 is going to be welded to slope panels P-014, P-015, P-016, P-017, P-018, **DO NOT** log as P-001/1014-018. Each seam segment must be logged individually as P-001/014; P-001/015; P-001/016; P-001/017; and P-001/018.

2 When Multiple Layers are being installed, start secondary panels with an S-prefix (S-001/002) and Primary panels with a P-prefix (P-001/002).

3 If doing multiple cells or ponds, Start panels with prefix and pond number (Pond 1 P-1001/002, Pond 2 P-001/002, Pond 3 P-3001/002).

4 Extrusion welded seams that are on Seaming Form must be logged on Non-Destructive Testing Form

5 Test Location: This needs to be consistent throughout the company and from crew to crew. Everyone needs to record test locations the same way. If the seam is tested from one end to the other, complete, no more seam to be tested, , not segmented – then log the seam as **ELOS** (entire length of seam).

If the seam has to be tested in segments:

Lets say seam P-001/002 is 520 feet long, runs north-south and has holes at 150', 250-275 feet, 287 feet and 467 feet.

If the non-destructive test starts at the south end of seam, log the test as SEOS-100' (give the starting point and the direction of travel. Do not start at 0. We do not know where 0 is in the office). If a patch (let say a 2 x2 patch) is going to cover the area, DO NOT restart at 152 ft. Start at the point you just completed (that is 150 ft or measure to the middle of the test section). 150-250'.

Note that now there is a large gap between 250-275 feet (25 feet). This section needs to be logged with the repair number: 250-275 capped by R-15.

Complete the next section from the end of the capped section: 275-287. Complete the next section 287-467. The final section will be 467-NEOS (do not give the seam length).

If done correctly you should be able to read and hear the completed seam. For example read and listen to the following example again:

SEOS-100 - South end of seam to 100 feet North
100-250 - 100 feet North to 250 feet North
250-275 Capped by R15 - 250 feet North to 275 feet North Capped by Repair15
467-NEOS - 467 feet North to North end of seam

Is this seam completed? NO it's not. There is a gap between 275-467

SEOS-100 - South end of seam to 100 feet North
100-250 - 100 feet North to 250 feet North
250-275 Capped by R-15 - 250 feet North to 275 feet North Capped by Repair15
275-287 – 275 feet North to 287 feet North
287-467 – 287 feet North to 467 feet North
467-NEOS - 467 feet North to North end of seam

Is this seam completed? Yes, all sections are accounted.

Unless there is a cap, report all air tests to the center of the repair location.

6 Perform Nondestructive Testing prior to removing destructives.
7 If a seam or seam segment con not be tested, log the repair number of that seam segment in the test location area.

8 **ALWAYS LOG THE LOWER PANEL NUMBER FIRST.** P-002/001 is incorrect. This should be P-001/002. Look to see what is around you, take a deep breath and log it right.

9 Use a new form Daily. Start each new days form at page no 1.

10 File completed forms in a completed form file.

HELPFUL HINTS:

Generally Air Pressure Tests need to be held for five minutes. If you are consistent with your Air Pressure testing you can record the start times in the field and fill in the end times for five minutes later when you are checking the data to save time in the field. Remember to check the specification to make sure the required test time is five minutes. And if your tests are taking more or less time record the correct times.

Destructive Test Form

Parts of the Form

GSI
DESTRUCTIVE TEST FORM

Page _F__ of ___

PROJECT NAME:	A	Test Criteria	G mil	
PROJECT NO.:	B	Fusion Peel	H	
MATERIAL TYPE:	C	Extrus Peel	I	
MATERIAL LAYER	D	Peel Sep.	J	
QC NAME:	E	Shear	K	

Sample I.D.	Seam NO.	Tech Initials	Machn No.	Peel (ppi)										Shear (ppi)					Pass Fail	SAMPLE LOCATION
				1		2		3		4		5		1	2	3	4	5		
L	M	N	O	P	P	P	P	P	P	P	P	P	P	Q	Q	Q	Q	Q	R	S

Trial rev. 4
March 2010

A Project Name – This is the project name given by the office. Do not makeup your own name. For example, Ameren Duck Creek is Ameren Duck Creek NOT Canton IL.

B Project Number – Assigned by the office. Do not makeup a number.

C Material Type – Examples 60 mil HD, 40 mil LLDPE, Composite

D Material Layer – Examples: Primary, Secondary, Rain Flap, Sacrificial ect.

E Name – Your Name.

F Page Number.

G MIL – Material Thickness (40, 60, 80, 100 mil)

H Fusion Peel – Poundage required obtain from project specification.

I Extrus Peel - Poundage required obtain from project specification.

J Peel Sep. – Allowable Peel Separation obtained from the project specifications.

K Shear - Poundage required obtain from project specification.

L Sample I.D. – Test Number.

M Seam Number – Seam the sample was taken from.

N Seamer Int. – Technician who performed the seam being tested.

O Mach. NO. – Machine that performed the seam being tested.

P Mach. NO. – Machine that performed the seam being tested.

Q Shear (ppi) - Shear Test Value Poundage.

R Pass/Fail – P=Pass, F=Fail.

S Sample Location – Sample location on the seam measured from the end of the seam and the same location as the Repair Log location.

Filling Out the Form

1 Run form continuously and file when each page is completed.

2 If the project you are on has multiple layers (such as a primary and secondary liner) start destruct numbers DS-001 for secondary and DP-001 for Primary Liners.

3 If the project you are on has multiple cells or ponds (for example Pond 1, Pond 2 and Pond 3) Start panel numbers at DP-1001 for pond 1, DP-2001 for Pond 2, and DP-3001 for Pond 3, or 1DP-001 for Pond 1, 2DP-001 for Pond 2, and 3DP-001 for Pond 3.

Tracking a Failed Destructive

Tracking a failed destructive test will be outlined in the project specifications. However, there are some fundamentals that must be followed. A failing destructive must be tracked each direction to passing destructive tests. These additional destructive tests may or may not be on the same seam as the original destructive test and possibly on a seam welded on different days. In the panel seaming section you were asked to place each welder on their own welding form and to keep up with seaming as it occurred. Tracking a failed destructive is easier if you follow this method. Locate the seaming form that contains the seam with the failed destructive. Follow the times that the welder performed each seam to track the weld path.

By convention, the retest destructive tests will have an A and B component. The A component represents all welding that occurred after the destructive was placed. The B component represents all welding that occurred before the destructive was placed (A=After, B=Before). If the retest fails, the next test in the After direction will be A1and the retest in the B direction will be B1 If these test fail, the next test numbers will be A2 and B2.

For example, if DP-002 fails the rest sequence will be DP-002A, DP-002A1, DP-002A3, DP-002B, DP-002B1, DP-002B2 ect.

When tracking a failed destructive test, the seam segment between retest must be logged on the Repair Form.

HELPFUL HINTS:

Repair Form
Parts of the Form

GSI
REPAIR FORM

Page __F___ of _____

PROJECT NAME:	A
PROJECT NO.:	B
MATERIAL TYPE:	C
MATERIAL LAYER:	D
QC NAME:	E

Repair No.	Seam / Panel No.	Location of Repairs	Repair Date	Repair Tech	Repair Type*	Repair Size	Vacuum Test Date	Test Tech	Test P/F
G	H	I	J	K	L	M	N	O	P

* Repair Type: P=Patch, C=Cap, B=Boot, DT=Destruct (with number), W= Weld, (explain any additional repairs)

Repair rev.4 March 2010

A Project Name – This is the project name given by the office. Do not makeup your own name. For example, Ameren Duck Creek is Ameren Duck Creek NOT Canton IL.

B Project Number – Assigned by the office. Do not makeup a number.

C Material Type – Examples 60 mil HD, 40 mil LLDPE, Composite

D Material Layer – Examples: Primary, Secondary, Rain Flap, Sacrificial ect.

E QC Name – Your Name.

F Page Number.

G Repair No. – Run Consecutively.

H Seam/Panel Number .

I Location Number.

J Repair Date.

K Repair Tech.

L Repair Type – P=patch; C=cap; B=pipe boot; DP, DS, DT=Destructive Test with number; W=Extrusion weld repair.

M Repair Size.

N Vacuum Test Date.

O Test Tech – The person who did the vacuum test.

P Pass/Fail – P=pass, F=fail.

Filling Out the Form

1 Keep the form in the field until sheet is completely filled out.

2 Patch is any repair that is less than half a roll width in any direction.

3 Cap is greater than half a roll width in any direction.

4 Marking Repair Locations:

Multiple Panel Intersection – Easiest to locate. In Seam/Panel No. list the panels that intersect in panel ascending order. P-001/002/003/004 not P-001/003/004/002. In location section write Intersection.

Repairs on a seam – Must have a N, S, E or W component. List N, S, E or W component as the direction of travel. That is a repair on seam P-001/002 45 N indicates you started at the south end of the seam and went 45 feet to the north. Remember panels zero out at a cross seam.

Repairs on panels – The most difficult to log. Must have a N/S and an E/W component. A repair on panel P-003 100 N, 10 E indicates you went 100 ft from the south end of the panel and 10 feet east. Do not log a repair on a panel with a seam number. That is if the repair is on panel P-003 100 N , 10 E DO NOT WRITE P-003/004 100 N, 10 E (this is a seam repair).

5 Repairs on weld log should be marked as “See Weld Log + Date of Weld Log”.

HELPFUL HINTS:

Try to record Repair locations starting on one side of the site. Always try to measure in the same direction. This makes it easier for others looking at your information to follow how the work progressed.

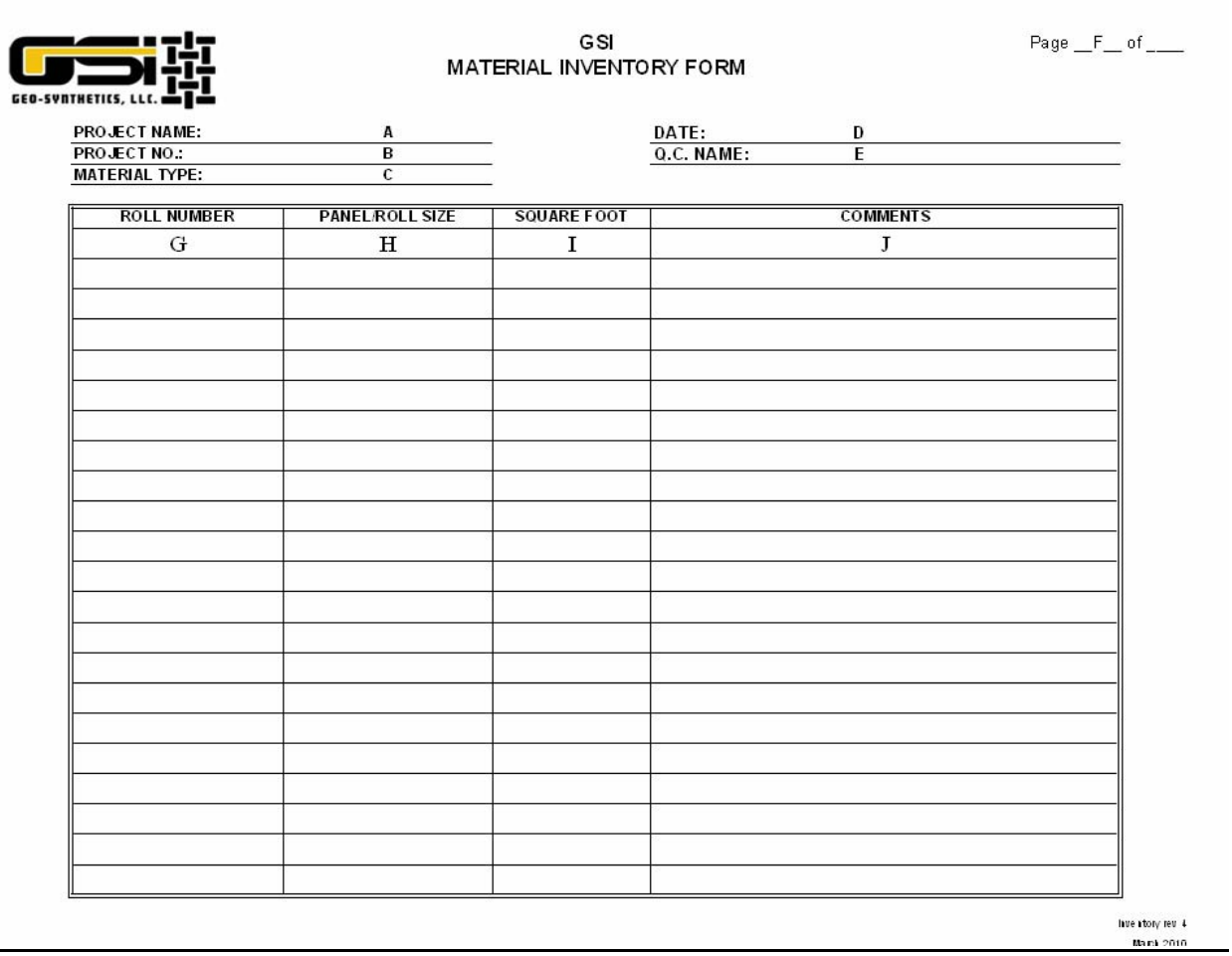
Checking Data

General

As mentioned earlier, collection of the field data is the most fundamental part of your job. However checking the data is probably the most important part. Inaccurate or erroneous data is useless. You are required to check your data on a daily basis. Do not assume that everything you have done in the field is completely correct. Everyone makes mistakes. It is better to correct these mistakes while you are in the field rather than when your data arrives in the office. The field forms have been setup with redundancies to assist with checking the data. If you find a mistake while you are onsite it will be easier to go and look at the liner and correct your mistake.

The following sections outline what data checks should be made.

Material Inventory Form



GSI
MATERIAL INVENTORY FORM

Page __F__ of ___

PROJECT NAME:	A	DATE:	D
PROJECT NO.:	B	Q.C. NAME:	E
MATERIAL TYPE:	C		

ROLL NUMBER	PANEL/ROLL SIZE	SQUARE FOOT	COMMENTS
G	H	I	J

General

1 Are Sections A – F completely filled out?

2 Are Sections G – I completely filled out?

Panel Placement Form

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PANEL PLACEMENT FORM

Page __F___ of ____

PROJECT NAME:	A
PROJECT NO.:	B
MATERIAL TYPE:	C
MATERIAL LAYER:	D
QC NAME:	E

PANEL NO.	ROLL NO.	PLACEMENT DATE	PANEL LENGTH (FT)	PANEL WIDTH (FT)	COMMENTS
G	H	I	J	K	L

Placement rev. 4

General

1 Are Sections A – F completely filled out?

2 Are Sections G – I completely filled out?

3 Sum roll lengths (Column J) for each corresponding roll in Column H and place and date total in column J of the *Material Inventory Form*.

Example: Roll 5838 is 520 feet long. Roll 5838 was used for panels P-001 (100 ft), P-002 (200), and P-003 (160 ft)

100+200+160=460 ft. 520-460=60 ft

In Comments Section (J) of Material Inventory Form write 60' remaining 12/31/10.

4 Remember to use a new form Panel Placement Form daily.

5 File completed paperwork in a "Completed Paperwork File".

This check will prevent using too much material off any roll. If your tally is larger than the roll length, you may possibly have the wrong roll number on a panel. For instance, if panels P-001+P-002+P-003=570 ft, something is wrong.

Trial Weld Form

GSI
TRIAL WELD FORM

Page _F__ of ___

PROJECT NAME:	A	Test Criteria	Fusion G mil	Extrusion mil
PROJECT NO.:	B	Time	H	
MATERIAL TYPE:	C	Number	I	
MATERIAL LAYER	D	ppi - Peel	K	
QC NAME:	E	ppi - Shear	L	

Date M

Trial No.	Sample Time	Air Temp	Mater Type	Tech Initials	Machn No.	Wedge Barrel	Speed Preheat	Peel (ppi) 1		2		3		4		5		Shear (ppi) 1	2	3	4	5	Pass Fail
No.	O	P	Q	R	S	T	U	V	V	V	V	V	V	V	V	V	V	W	W	W	W	W	X

*S/S = SMOOTH/SMOOTH; S/T = SMOOTH/TEXTURED; T/T = TEXTURED/TEXTURED

Trial rev. 4
March 2010

General

1 Are Sections A – X completely filled out?

If Air Temp and Material Type (Column P and Column Q) are not required, Place an NA in the top box and line to to the bottom of the column.

2 Renumber Column M in Time Ascending Order.

Trial Weld Form

Trial No.	Date of Trial	Time of Trial
1	12/31/09	850
2	12/31/09	830
3	12/31/09	815
4	12/31/09	900

Change to

Trial Weld Form

Trial No.	Date of Trial	Time of Trial
3	12/31/09	850
2	12/31/09	830
1	12/31/09	815
4	12/31/09	900

3 Use Military Time.

4 Are Trial Seams within the time limits indicated in Column H. If the specification requires Trial Seams every 4 hours, are the trial seams for each welder within that 4 hour limit (exclude lunch time).

5 Are the tested Peel Values (Column V) greater than or equal to the specified values (Column J and K)?

6 Are the tested Shear Values (Column W) greater than or equal to the specified values (Column L)?

7 Do all the values pass?

8 Start a new Trial Weld Form Each Day.

9 Start at Trial Seam No 1 each Day.

Tracking a Failed Trial Seam

Tracking a failed trial seam is dependent on the project specifications. It is not uncommon to have specifications that allow for retesting of a failed trial seam until passing tests are obtained. It is also common to allow for one retest and if this retest fails two passing retests are required. Additionally, some specifications will require two passing trial seams for each failure. Once again **KNOW YOUR SPECIFICATION.**

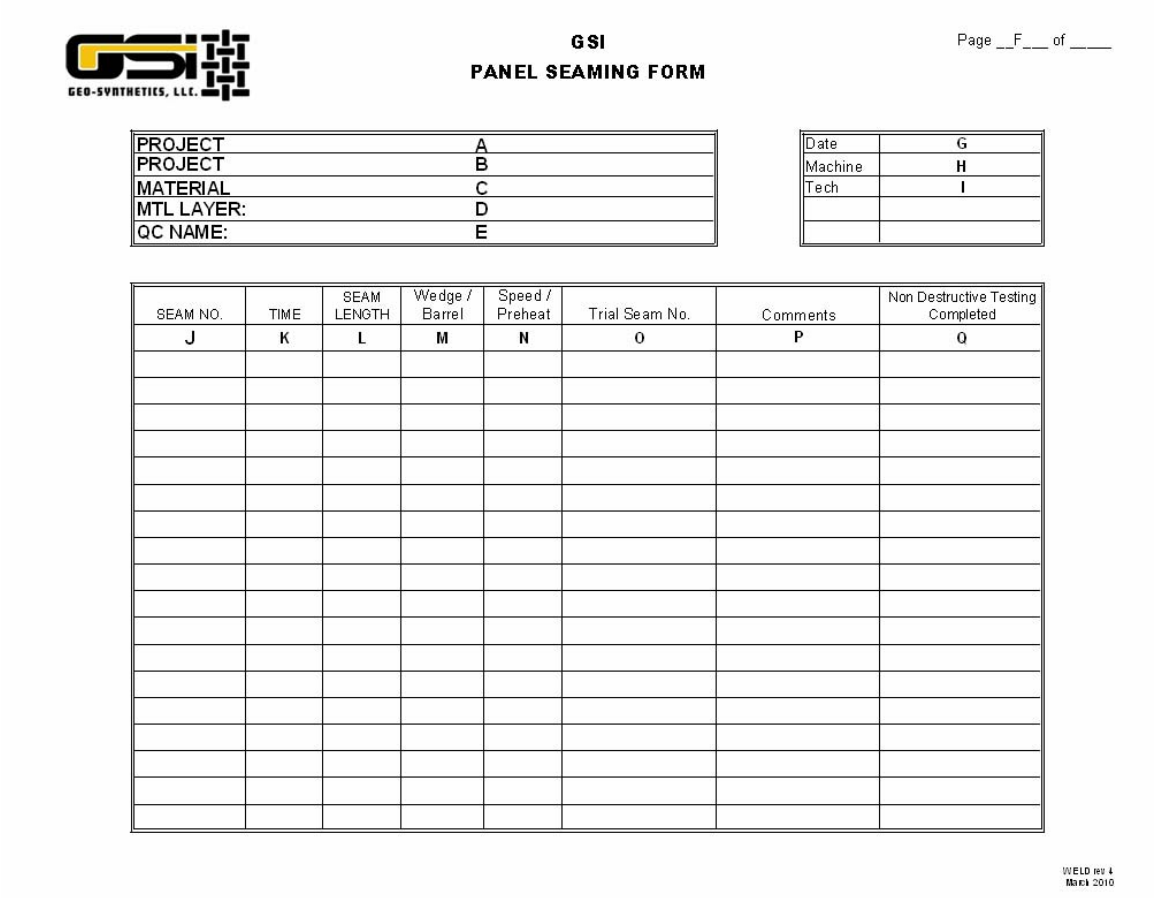
Failed trial seams must be tracked to passing trial seams. This is easy to do if you follow the subsequent convention:

Technician XX Fails Trial Seam No. 2. He retests. This test number is now 2R1. 2R1 fails and now XX needs two passing trial seams. These retests would be 2R2 and 2R3.

Trial Weld Form

Trial No.	Date of Trial	Pass Fail
2	12/31/09	F
2R1	12/31/09	F
2R2	12/31/09	P
2R3	12/31/09	P

Panel Seaming Form



GSI

PANEL SEAMING FORM

Page __F___ of _____

PROJECT	A
PROJECT	B
MATERIAL	C
MTL LAYER:	D
QC NAME:	E

Date	G
Machine	H
Tech	I

SEAM NO.	TIME	SEAM LENGTH	Wedge / Barrel	Speed / Preheat	Trial Seam No.	Comments	Non Destructive Testing Completed
J	K	L	M	N	O	P	Q

WELD rev 4 March 2010

General

1 Are Sections A – Q completely filled out?

2 Seaming Date (Column G) cannot be before panel placement date (Column I on the Panel Placement Form)

3 Place Trial Seam Number (Column M on Trial Seam Form) that corresponds to the seaming time in Column O on Panel Seaming Form.

Trial No	Date of Trial	Time of Trial	Technicians Initials	Welder Type	Wedge Barrel	Speed Preheat
1	12/31/09	800	XX	F-85	750	6

Seam No	Date	Time	Seam Length	Seamer Int	Machine No	Wedge Barrel	Speed Preheat	Trial No.
P-001/002	12/31/09	830	150	XX	F-85	750	6	1

4 Is the time on the Panel Seaming Form (Column K) earlier or later than the time in Column O of the Trial Seam Form? If the time on the Panel Seaming Form is earlier than the time on the Trial Seam Form YOU HAVE A PROBLEM.

5 Does the Tech and Machine number (Columns H & I on the Panel Seaming Form) match the Technician Initials and. and Welder Type (Columns R & S) in the Trial Seam Form?

6 Place Destructive Test Number in Comments section (Column P) on the Panel Seaming form if applicable.

7 Non Destructive Testing Completed (Column Q on the Panel Seaming Form) will be discussed in the next section Non-Destructive Testing Form.

8 File Panel Seaming Form in a “Completed Field Work” file when all the columns, Including Column Q have been completed.

9 Start a New Panel Seaming Form per Welder Each Day and restart page number (Column F on the Panel Seaming Form) at 1 each day.

Tracking Seaming

Periodically copy your Field Drawing. Take a highlighter and highlight the seams “AS THEY APPEAR ON YOUR PANEL SEAMING FORM. Do not assume that you have logged all seams. Check each seam individually. Any area that is not highlighted at the end of this exercise has not been logged on the Panel Seaming Form. Go back out to the field and log the missing seams.

Non-Destructive Testing Form

GSI
NON-DESTRUCTIVE TESTING FORM

Page __F___ of ____

PROJECT NAME:	A	Test Criteria	AIR TEST	Test Criteria	Vacuum Test
PROJECT NO.:	B	Start Pressure	G	Vac. Time	J
MATERIAL TYPE:	C	Test Time	H	Vac. Pres.	K
MATERIAL LAYER:	D	Accept. Drop	I		
QC NAME:	E				

Seam Number	Test Date	Tech Initials	Test Type (A or V)	Air Pressure Test		Time		Test Result (P or F)	Test Locations
				psi start	psi finish	Start	End		
L	M	N	O	P	Q	R	S	T	U

Non-D rev 4
March 2010

General

1 Are Sections A – U completely filled out?

2 Is Test Date (Column M on the Non-Destructive Testing Form) before the weld date (Column H on the Panel Seaming form)?

3 Is psi start (Column P) equal to or greater than Start Pressure (Column G)?

4 Is psi start (Column P) minus psi end(Column Q) less than or equal to Accept. Drop (Column I)? **IF NOT, YOU HAVE PROBLEMS!**

$$(P - Q) \leq I$$

4 Is Time End (Column S) minus Time Start (Column R) greater than or equal to Test Time (Column H)? **IF NOT, YOU HAVE PROBLEMS!**

$$(S - R) \geq H$$

5 Remember tracking format from Filling Out in the Non-Destructive Testing Field Work section: ELOS is Entire Length of Seam and seam segments must be in the form of SEOS-100, 100-250, 250-275 Capped by R15, 467-NEOS.

6 Check Seam Number (Column L) against Test Location (Column U). If the Seam is Completed, find corresponding seam on the Panel Seaming Form and place the completion date in the Non Destructive Testing Complete (Column Q) on the Panel Seaming Form.

7 Do not assume that, “We welded to day and we air tested to day so all the seams we welded are air tested”. Go through each non-destructive test individually.

8 When Column Q on the Panel Seaming Form is completed, file the form in a Completed Field Work file.

9 Remember a partially tested seam may possibly complete the Panel Seaming Form. For example: If seam P-001/002 is 500 ft and tech XX welded from the SEOS to 250 N, and welder YY welded from 250 N to NEOS and nondestructive testing was completed form 250 N to NEOS, this section can be logged on the Panel Seaming Form for that corresponding seam segment. If that completes that Panel seaming Form, file it. However, the seam segment from the SEOS to 250 N is not completed and the form needs to stay in the field.

10 File completed Non-Destructive Form in a Completed Field Work file.

11 Start a new Non-Destructive Testing Form daily and start at page number 1.

Tracking Seaming

Periodically copy your Field Drawing. Take a highlighter and highlight the seams “AS THEY APPEAR ON YOUR NON-DESTRUCTIVE TESTING FORM. Do not assume that you have logged all seams. Check each seam individually. Any area that is not highlighted at the end of this exercise has not been logged on the Non-destructive Testing Form. Go back out to the field and log the missing seams.

Destructive Test Form

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DESTRUCTIVE TEST FORM

Page _F__ of ___

PROJECT NAME:	A	Test Criteria	G mil	
PROJECT NO.:	B	Fusion Peel	H	
MATERIAL TYPE:	C	Extrus Peel	I	
MATERIAL LAYER	D	Peel Sep.	J	
QC NAME:	E	Shear	K	

Sample I.D.	Seam NO.	Tech Initials	Machn No.	Peel (ppi)										Shear (ppi)					Pass Fail	SAMPLE LOCATION
				1		2		3		4		5		1	2	3	4	5		
L	M	N	O	P	P	P	P	P	P	P	P	P	P	Q	Q	Q	Q	Q	R	S

Trial rev. 4
March 2010

General

1 Are Sections A – 5 completely filled out?

2 Do Columns M, N, and P on the Destructive Test Form correspond to Columns J, H, and I on the Panel Seaming Form?

3 Do Columns M and S on the Destructive Test Form correspond to Columns H and I on the Repair Form?

4 Do the vales in Column P of the Destructive Test Form meet or exceed the values of H or Column I on the Destructive Test Form?

5 Do the vales in Column O of the Destructive Test Form meet or exceed the values of K on the Destructive Test Form?

6 Consecutively number Sample I.D. (Column M on the Destructive Test Form. File the completed page when all information on the sheet has been filed out.

Repair Form

GSI
REPAIR FORM

Page __F___ of _____

PROJECT NAME:	A
PROJECT NO.:	B
MATERIAL TYPE:	C
MATERIAL LAYER:	D
QC NAME:	E

Repair No.	Seam / Panel No.	Location of Repairs	Repair Date	Repair Tech	Repair Type*	Repair Size	Vacuum Test Date	Test Tech	Test P/F
G	H	I	J	K	L	M	N	O	P

* Repair Type: P=Patch, C=Cap, B=Boot, DT=Destruct (with number), W= Weld, (explain any additional repairs)

Repair rev.4
March 2010

General

1 Are Sections A – P completely filled out?

2 Check Repair Tech (Column K on Repair Form) with Technicians Initials (Column R on Trial Weld Form).

3 Is Test Date(Column N on Repair Form) before Repair Date (Column J on Repair Form?

4 Run Page Number Consecutively.

5 File Form when all fields have been completed.

Record Drawing

The third aspect of your position, in addition to collecting and checking the field data, is to create a field record drawing of the project that is required by most specifications. This record drawing needs to accurately reflect the panels, seams, and repairs and their relationship to each other. As you know a picture is worth a thousand words. This record drawing is used by GSI QC Staff in double checking the field data and is often submitted to the Project Owner to be meet regulatory requirements.

Required Information

Because the record drawing is so important it needs to accurately reflect how the material was installed, tested, and repaired. This means it needs to be done to scale and include all of the information collected on the field forms. Information that needs to be included on the record drawing includes:

- Panel Numbers
- Seams drawn to the correct Length
- Seam Orientation, especially important in corners
- Destructive Test Locations
- Repair Types and Locations
- Site Orientation, which way is North. This may not always be the same, ask the Third Party Engineer or the General Contactor if there is a site specific North. The outlines that are created in the office for your use most times have a North arrow on them but you need to verify that this is correct
- Any Changes to the Layout of the Site. Sometimes the outlines and panel layouts you are provided may be different from what is being built. If this occurs you need to track this on your record drawing. This is necessary to determine if the project got bigger or smaller so adjustments can be made to make sure GSI gets paid for the work we've done.
- The correct name and location of the project and the material used. This is often also provided on panel layouts and outlines, but if it is not you need to obtain this information so company records can be updated
- Information about the drawing and who completed the drawing. Note what layer and material is shown and include your name as the person who prepared the record drawing

Drafting Requirements

To produce an accurate and complete record drawing requires some drafting skills. These skills are fairly basic and can be aided by the proper equipment. The idea is too take

something complicated and make it easier to understand. Too much information on a drawing can be as bad as too little information. Using symbols and abbreviations makes this possible.

Tools

The tools necessary to create a record drawing do not have to be complex. A piece of paper, pencil, and a simple ruler is all that would be needed to create a basic record drawing. Because not all record drawings are basic the following list of tools is recommended:

- Three sided Engineer's Scale with 20, 30, 40, 50 and 60 feet to the inch scales
- A mechanical pencil and eraser
- Drafting Triangles with 30, 45, 60, and 90 degree angles
- Multi-function calculator with Square Root function
- T-Square or straight-edge
- Drawing Board or other similar hard surface
- Paper large enough to draw the project at an appropriate scale
- Compass
- Protractor

Some people think that it is necessary to have a computer program in order to create an accurate record drawing. This is not true because if the information that was collected is not accurate the drawing will not be accurate either. **THE COMPUTER CANNOT MAKE A GOOD DRAWING FROM BAD INFORMATION**. The tools listed above are a complete list of what you should have. If you do not have all of these tools that is not an excuse for poor record drawings, because most drawings can be completed with three basic tools listed in the first paragraph.

Drafting Standards

In order for your record drawing to accurately reflect the installation it must conform to some basic standards. Some of these standards are universal and some are company specific.

- Scale: Use one of the Common Engineering Scale (20, 30, 40, 50, or 60). 40 and 50 scale are the most common for the projects we do. With 60 scale it becomes too difficult to write the necessary information on the drawing because the panels are too small. 20 and 30 scale are fine for small projects and allow room for more information. You need to decide based on the size of the project and the paper you have what scale to use. 40 scale would work well in the field because every quarter inch is 10 feet if you do not have a 3 sided scale with you a regular tape measure would work.
- Text should read from left to right and top to bottom without turning the sheet. Try to orient your panel numbers this way it makes it much easier to read. Not all information will be able to be placed this way due to space restrictions.
- Straight, Perpendicular, and Parallel. These three concepts make drawings much easier to read.

  - Straight: When completing your record drawing to send to the office utilize your straight edge to make your lines straight. Do not freehand at this point, it can make drawings distorted
  - Perpendicular: While our panels do not always create right angles to each other, when they do it is important to draw as such. If this standard is not followed the error is multiplied across the drawing and the panels will not line-up as they do in the field
  - Parallel: Every roll is 22 feet wide for its entire length. So, unless a panel is trimmed to fit each panel should be parallel to the one next to it. Panels should not be drawn as 18 feet wide on the South end and 23 feet wide on the North end
- Symbols and Text. GSI has its own set of symbols to indicate different types of repairs and seams. Abbreviations are also used to identify Panels, Repairs and Destructive Tests
  - Patches are symbolized by a filled circle. These circles should approximate the size of the repairs
  - Cap Patches are symbolized by filled rectangles. Draw the rectangles the size of the repairs
  - Boots are symbolized by a circle with an X inside. Each pipe should be marked as a boot
  - Extrusion Welds are designated by a zig-zag line. This should be for the entire length of the weld
  - Fusion Welds are designated by a straight line
  - Panel Numbers should be written as described in previous sections to match the designation on the Field Forms
  - Repairs should be numbered as R## the same as on the Field Forms. If repairs are numbered on the Repair Forms they need to be numbered on the Record Drawing and vice versa. Repairs do not have to be numbered unless required by the specification. Numbering does make it easier to track repairs.
  - Destructive Tests should be written the same as on the Field Forms as described in previous sections. Destructive Tests are symbolized as an open square followed by the Destructive Test Number.

Sketches

One of the most helpful things you can do is to create sketches of areas of the liner to be incorporated in your record drawing. Make sketches of complicated areas: corners, toe to slope tie-ins, new to old tie-ins, and any areas with multiple repairs in close proximity. These sketches

can be aided by pictures. If you are having trouble drawing an area take many pictures to help the drafters in the office create the record drawing.

Sketches also keep your record drawing clean because it does not have to be in the field with you. Sketch the work completed each day and then add it to your record drawing.

Drawing a liner installation is not always the easiest task because you are taking a three dimensional thing and trying to represent it in two dimensions. This is especially difficult in corners and other areas where the grade change is extreme. Whatever the difficulty the drawing needs to be representative of the field data, **you should not change the field data to make a drawing look better**.

APPENDIX

Information that may be useful to you in the field

Formulas

L=Length

W=Width

R=Radius

D=Diameter = R x 2

C=Circumference

A=Area

B=Base Length of a Right Triangle

H=Height of a Right Triangle

Area of a Rectangle $A = L \times W$

Area of a Right Triangle $A = (B \times H)/2$

Length of the Long Side of a Right Triangle $L = \sqrt{(B^2+H^2)}$

Area of a Circle $A = 3.14 \times R^2$

Circumference of a Circle $C = 2 \times R \times 3.14$

Seam Failure Modes

Pages 53 and 54

QC Technicians Quick Reference Guide

Pages 55 and 56

A-Size Border with Drafting Symbols

Attached

Field Forms

Attached

GEO-SYNTHETICS, LLC.FIELD QUALITY CONTROL MANUAL

Attached

Locus-of-Break codes for Fillet Extrusion Weld Seams Tested for Seam Strength in Shear and Peel Modes.

Type of Break	Code	Break Description
	AD-1	Failure in adhesion. Specimens may also delaminate under the bead and break through the thin extruded material in the outer area.
	AD-2	Failure in adhesion.
	AD-WLD .	Break through the fillet
	SE-1	Break at seam edge in the bottom sheet. (Applicable to shear tests only.)
	SE-2	Break at seam edge in the top sheet. (Applicable to shear tests only.)
	SE-3	Break at seam edge in the bottom sheet. (Applicable to peel tests only.)
	BRK-1	Break in the bottom sheeting. A "B" in parenthesis after the code means the specimen broke in the buffed area.
	BRK-2	Break in the top sheeting. A "B" in parenthesis after the code means the specimen broke in the buffed area.
	AD-BRK	Break in the bottom sheeting after some adhesion failure between the fillet and the bottom sheet.
	HT	Break at the edge of the hot tack for specimens which could not be delaminated in the hot tack.
	SIP	Separation in the plane of the sheet.

(1) Acceptance of AD-Weld breaks depends on whether test values meet a minimum specification value.

Locus-of-Break codes for Dual Hot Wedge Seams Tested for Seam Strength in Shear and Peel Modes.

Type of Break	Code	Break Description
	AD	Adhesion Failure.
	BRK	Break in Sheeting. Break can be either top or bottom sheet.
	SE-1	Break in outer edge of seam. Break can be in either top or bottom sheet.
	SE-2	Break at inner edge of seam through both sheets.
	AD-BRK	Break in first seam after some adhesion failure. Break can be either top or bottom sheet.
	SIP	Separation in the plane of the sheet. Break can be in either top or bottom sheet.

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Panel Placement

1) Is the paper work completely filled out

Trial welds

1) Is the paper work completely filled out
2) Do all the tests meet the required passing values
3) Are test within the proper time intervals

Welding

1) Is the paper work completely filled out
2) Are all panels welded on the day that they were placed
3) Do trial seams match the tech and welding machine used that day
4) Are trial seams within the proper time interval

Nondestructive Testing

1) Is the paper work completely filled out
2) Do all the tests pass
3) Are the test within the proper time interval
4) Do tests correlate to welded seams and dates

Destructive Testing

1) Is the paper work completely filled out
2) Do all the tests meet the required passing values
3) Does the tech and machine correlate to the tech and machine on the seaming log
4) Does the destructive location correlate to the repair location
5) If the destructive failed, was it tracked properly

Repairs

1) Is the paper work completely filled out
2) Does the repair tech have a trial seam
3) Are Repairs located correctly on the drawing
4) Does the repair location correlate to the destructive location

Geo-Synthetics LLC.
2401 Pewaukee Road Waukesha, WI 53188
www.geo-synthetics.com

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Drawing

1) Is your drawing up to date
2) Do repair locations and destructive locations on drawing match the repair logs

Drafting Symbols