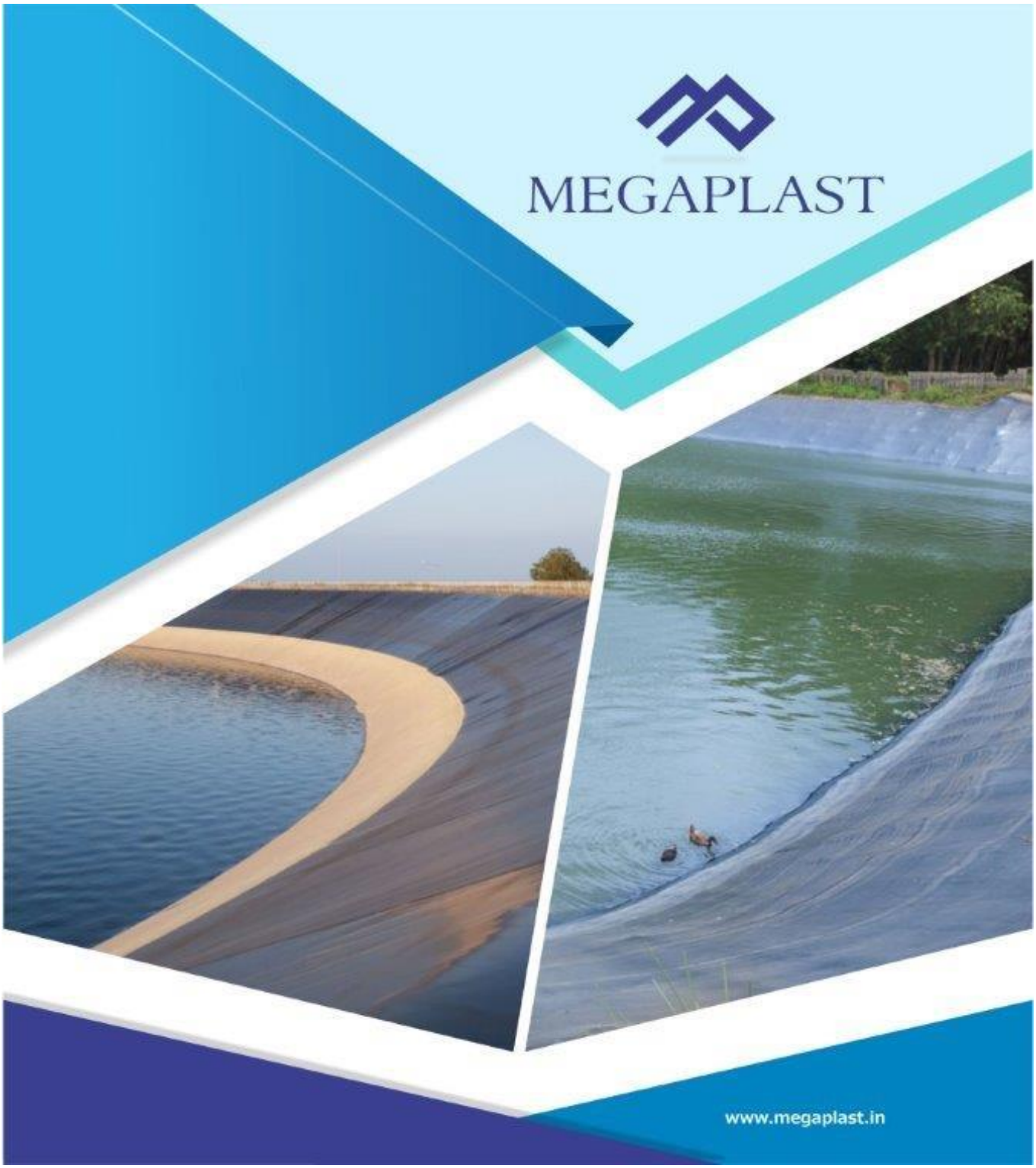

Head Office Address

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CONTENTS

Chapter 1.0: Introduction

M/S MEGAPLAST INDIA PVT.LTD is dedicated to an objective of continuous commitment to quality & innovative ideas are leading the way into the future of geosynthetics and their applications. Our dedication begins with the manufacture of the geomembrane material and ends only when our customer has accepted our liner. Over the years, our product range and fields of application have continuously grown.

Our Programs and procedures designed to implement this quality principle are developed by the Quality Control Department and are utilized by every employee of the Company. We now offer product development and design, with a design-by-function and application approach, to satisfy even your most challenging project objectives.

This installation manual followed by the installer to assure quality workmanship throughout the installation of the M/s Megaplast HDPE/ LLDPE Geomembrane .

Megaplast is having an ISO 9001-2008 QMS with state of the art testing laboratory accredited by NABL (National Accreditation Board for Testing and Calibration Laboratories) and GAI-LAP (Geosynthetic Accreditation Institute Lab Accreditation Program) certification. Megaplast Geomembranes are being manufactured as per GRI GM-13 specifications, BIS and CE certified too.

1.1 Standard Test Method

This specification refers to the following Standards, Specifications or Publications

ASTM D 6392: Standard Test Methods for Determining The Integrity of Non-Reinforced Geomembrane Seams Produced Using thermo Fusion Methods

ASTM D 5641: Standard Practice for Geomembrane Seam Evaluation by Vacuum Chamber

ASTM D 5820: Standard Practice for Pressurized Air Channel Evaluation of Dual Seamed Geomembranes

ASTM D 7240: Standard Practice for Leak Location using Geomembranes with an Insulating Layer in Intimate Contact with a Conductive Layer via Electrical Capacitance Technique (Conductive Geomembrane Spark test).

ASTM D 6497: Standard Guide for Mechanical Attachment of Geomembrane to penetrations or Structures .

GRI Test Method GM 9: Standard Practice for Cold Weather Seaming of Geomembranes

GRI Test Method GM13: Test Properties, Testing Frequency and Recommended Warranty for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes .

GRI Test Method GM 17: Test Properties, Testing Frequency and Recommended Warranty for Linear Low Density Polyethylene (LLDPE) Smooth and Textured Geomembranes .

GRI Test Method GM14: Selecting Variable Intervals for taking Geomembrane Destructive Seam Samples Using the Method of Attributes

GRI Test Method GM19: Standard Specification for Seam Strength and related Properties of thermally Bonded Polyolefin Geomembranes

Chapter 2.0: Material Delivery, handling, Identification, storage and delivery control

2.1 Delivery and handling

The transportation of the Megaplast HDPE/ LLDPE Geomembrane can be performed through an independent shipping or trucking firm or by the purchaser.

The equipment used to handle the rolls must allow the handling, with ease, of a 2,000 kg (4400 lb) roll, without damaging it. Each 8.00 m wide roll is equipped with two polyester or nylon slings to allow the forklift to handle it properly. It is also possible to introduce a lift truck's metal axis in the roll core to move it.

Picture 1: slings for 8.00 m wide rolls

Picture2 : Loading with pole in box containers

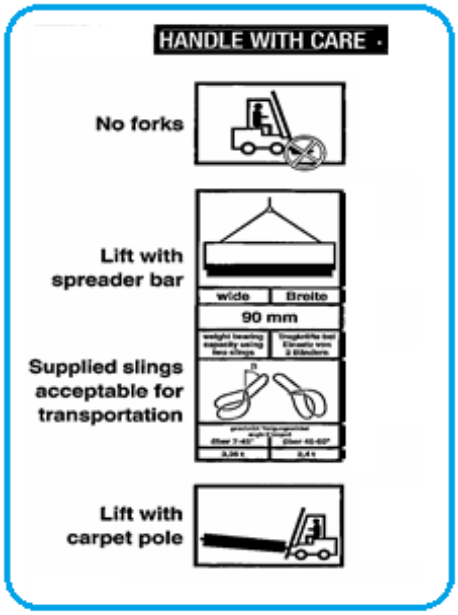
The geomembrane material is transported to the site in rolls, and stored as detailed in paragraph 2.3 below.

2.2 Identification

Each manufactured roll is given a unique roll number, regardless of the type of material. All manufacturing and quality control data relative to each roll is stored in the same database, under the roll number. This information allows Megaplast to keep track of all the rolls produced, quality control results, roll dimensions and weight, date shipped, client name , etc. (MIPL/F/QA/20).

Each roll is identified immediately with at least three labels: one inside the core and two others under the first wrap of material, directly on the geomembrane sheet, at each end of roll. These labels show the roll number, thickness, batch No., product code, dimensions, Manufacture Name and date of manufacture. These roll tags must be legible, waterproof and printed with non-fade ink.

The un-loading instructions from M/S MEGAPLAST are attached to each container and should be read. Operators should follow existing national safety requirements.



Damage during un-loading shall be documented by the inspector or installer. Damaged rolls must be separated from the undamaged rolls.

Photographs of the damage with the delivery truck or container shall be taken and such damage report to M/S MEGAPLAST immediately together with the roll number and not later than 2 days after unloading,

2.3 Storage

The rolls are to be stored on a smooth surface free of stones and rubble which could damage the rolls. The rolls shall be protected from excess of water, mud, dirt, dust, puncture, cutting or any other damaging or deleterious conditions. If necessary a protection layer of sand, minimum thickness 100 mm, or a thick nonwoven geotextile (> 600 g/m²) should be used if small stones (≤ 4 mm) are within the surface of the storage area. Large stones (> 4 mm) etc. must be removed.

The rolls shall be kept clean. The polyethylene geomembrane rolls do not need a protective wrapping for outside storage. If the rolls are to remain outside for longer than 2 month, they should be covered by a tarpaulin or similar, which must be secured so that even in strong wind conditions the cover remains secure.

The geomembrane rolls can be stacked up to 4 rolls high for smooth geomembrane and up to 3 rolls high for textured geomembrane, without crushing the core.

Picture 3: storage on site

2.4 Delivery control

The M/S MEGAPLAST purchaser shall ensure that an authorized representative of the company responsible for the M/S MEGAPLAST rolls shall control that the roll numbers, written at the end of rolls are the same as the roll numbers given on the delivery note. Any discrepancies shall be notified to M/S MEGAPLAST within 2 days after arrival on site.

Chapter 3.0: HDPE/LLDPE Geomembrane Installation Quality Assurance

3.1 Subgrade Preparation

Installer is not responsible for the natural calamity on a job site. The subgrade is prepared by the owner or by the contractor according to the project tender specifications. The surface must be smooth, with no rapid changes of grade such as steps or settlement next to concrete structures. All slopes and surfaces must be compacted to ensure the integrity of the membrane. While the geomembrane is designed to withstand some differential settlement, an analysis of these areas must be made by the engineer to ensure that the stresses on the membrane are acceptable.

The surface of the subgrade must be free of sharp rocks, penetrating debris or other appurtenances that could damage the membrane. Typically, finished subgrade is achieved using a smooth steel drum roller or other method as approved by the Project Engineer. Under certain conditions a cushion geotextile can be evaluated and approved for use by the Project Engineer, to provide protection for the geomembrane.

The installer site engineer shall approve the surface (daily basis) on which the geomembrane will be installed and acceptance of the finished subgrade surface shall be recorded.

3.2 Geomembrane Panel Deployment

Prior to the beginning of a project, it is recommended that the geomembrane installer produces a proposed panel layout showing the location of all geomembrane panels. This panel layout is submitted for information purposes only and is usually based on the project plans and specifications.

During the geomembrane liner installation, the panel deployments might differ from the proposed layout as construction progresses. The actual field panel deployments will be shown on the as-built drawing of the project. The as-built drawing shows all panel locations, panel identification, patches and destructive test locations.

Picture 4: Geomembrane Panel Deployment

Please follow below International Regulations for the Geomembrane panel deployment based on the recommendations of the International Association of Geosynthetic Installers:

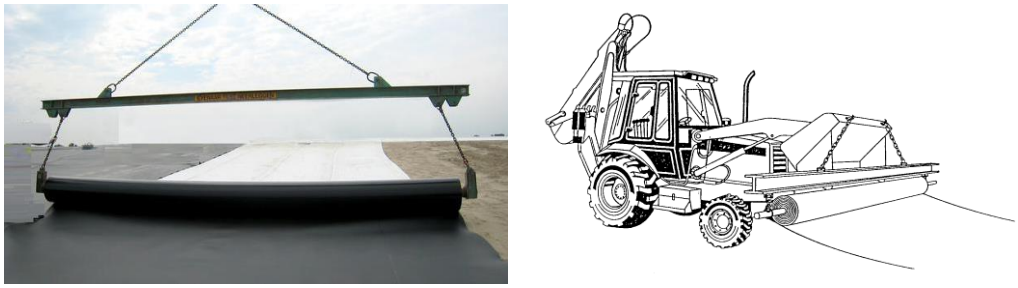
- No geomembrane material shall be unrolled and deployed if the material temperatures are lower than 0° C unless otherwise approved by the Owner's Representative. The specified minimum temperature for material deployment may be adjusted by the Owner's Representative based on recommendations from the manufacturer. Typically, only the quantity of geomembrane that will be anchored and seamed together in one day should be deployed.

- Nobody shall be allowed to walk on the geomembrane when wearing shoes that could puncture, scratch or otherwise damage the geomembrane.
- No vehicular traffic shall travel on the geomembrane other than an approved low ground pressure all-terrain vehicle or equivalent.
- Sand bags or equivalent ballast shall be used as necessary temporarily to hold the geomembrane material in position under the foreseeable and reasonable- expected wind conditions. Sand bag material shall be sufficiently close-woven to prevent soil fines from escaping from the bags and discharging onto the geomembrane.

Picture5: hold the geomembrane with sand bag in position

- Geomembrane placement shall not be done if moisture prevents proper sub grade preparation, panel placement, or panel seaming.

- Geomembrane placement shall not be done if moisture prevents proper sub grade preparation, panel placement, or panel seaming.
- Damaged panels which have been rejected shall be marked and their removal from the work area recorded.
- The geomembrane shall not be allowed to "bridge over" (also called trampolining) voids or low areas in the sub grade. In these areas, the geomembrane shall rest in intimate contact with the sub grade.
- Wrinkles caused by panel placement or thermal expansion should be minimized.



Picture 6: Deployment *of 8.00 m wide geomembrane* Panel process

- In general: seams shall be oriented parallel to the line of the maximum slope. In corners and odd shaped geometric locations, the total length of field seams shall be minimized. Seams shall not be located at low points in the subgrade unless geometric requires seaming at such locations and if approved by the Owner's Representative.
- The panels shall be overlapped prior to seaming. The special white lines parallel to the edges shows the correct overlapping dimension to avoid mistakes.
- The geomembrane panels shall not be deployed and left unseamed overnight. Whenever weather conditions are uncertain or not adequate for field seaming, no geomembrane deployment shall take place. Extreme temperatures, high humidity, rain, high winds etc. are all conditions not favorable to field seaming. The site foreman and QC-Inspector should determine whether seaming can be conducted properly so as to achieve quality seams.

- The geomembrane material must be homogeneous, free from pores and, apart from a surface texture that may be required, it must be smooth and watertight. The geomembranes shall be produced in the factory with protective plastic film strips along the bonded edges which can be removed without a residue.

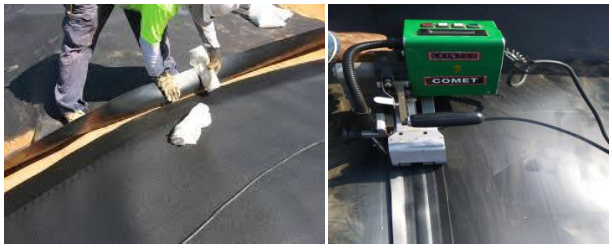
3.3 Site seaming procedure

All seams must be oriented down the slope, not across. Tie - in seams (perpendicular to the slope) should be located within 1.5 m (5 feet) from the toe of the slope in the flat area. The Quality Control Inspector on site shall document all seaming procedures using the Seaming Procedures. The field documentation of the seaming procedures shall include the seam number, date and time of seaming, technician welder, seam length and reference to the corresponding test seam (calibration).

Where conditions warrant, the Installer shall be allowed to use a temporary support surface between the geomembrane and the subgrade to achieve proper support during the seaming operation. Seaming shall be a continuous process with a minimum of interruptions along any given seam. Prior to seaming, the geomembrane shall be overlapped a minimum of 100 millimeters for extrusion welding and 100 to 150 millimeters for fusion welding. Any geomembrane area showing injury due to excessive scuffing, puncture, or distress from any cause shall, at the discretion of the installer's onsite supervisor, be repaired or replaced with an additional piece of geomembrane.

No geomembrane material shall be seamed when the sheet temperature is > 60 °C as measured by an infrared thermometer or surface thermocouple unless otherwise approved by the Owner's representative. This approval will be based on recommendations by M/S MEGAPLAST and on a field demonstration by the geomembrane installer using prequalification test seams to demonstrate that the seams comply with the specification.

Seaming shall primarily be performed using automatic fusion welding equipment and techniques. Extrusion welding shall be used where fusion welding is not possible such as pipe penetrations, patches, repairs and short (less than a roll width) runs of seams.



Picture 7: welding of geomembrane

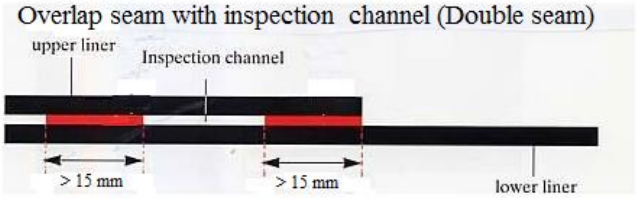
Excessive wrinkles at the seam overlaps shall be minimized and when necessary cut along the ridge of the wrinkles into the panel so as to effect a flat overlap. The cut shall be terminated with a keyhole cut (nominal 10 mm (½ in) diameter hole) so as to minimize crack/tear propagation. The overlay shall subsequently be seamed. The key hole cut shall be patched with an oval or round patch of the same base geomembrane material extending a minimum of 150 mm (6 in.) beyond the cut in all directions.

3.4 Welding procedures

3.4.1 *Environmental conditions* : Liner deployment shall only proceed between ambient temperatures of 5 °C to 45 °C. Deployment shall proceed above 45 °C only after it has been verified that the material can be seamed according to the specification. Deployment shall not be made in the presence of excessive moisture (e.g. fog, rain and dew) or in the presence of excessive winds. Liner seaming shall only proceed when the humidity is < 83 % for extrusion welding and < 90 % for hot wedge welding. When the humidity exceeds these values, seaming shall only proceed after it has been verified that the material can be seamed according to the specifications

3.4.2 ***Fusion Welding:*** The geomembrane shall have an overlap between 100 to 150 millimeters . The area shall be prepared by wiping the area with a clean dry cloth to remove any foreign matter. The welder shall be inserted at one end of the seam, then the pressure rollers are to be clamped down and the wedge engaged and drive motor turned on. If the welder is interrupted during the seaming process, the area affected shall be marked and repaired.

Picture 8 : welding machine for fusion welding



Picture 9: Overlap seam with inspection channel

The welding machine is aligned and set to the required temperature depending on the material thickness and air-temperature, and the machine travel speed is to set to the required setting for the applicable material thickness and surface temperature.

Example of possible machine settlings:

Wedge temperature: 310 °C - 420 °C
Specific mating force: 30 - 40 N/mm width of rollers
Welding speed is 1 - 2 m/min

When the welding machine is operating as required, a trial seam is made on strips of the lining material.

Trial welds shall be performed on geomembrane samples to verify welding equipment operations and performance of seaming method and conditions.

Minimum of two trial welds per shift per welding apparatus will be made, one made prior to the start of work and one completed mid shift. Welds shall be made under the same surface and environmental conditions as the production weld.

The test on the trial seam must be successful before the final welding of the geomembrane starts.
Trial weld testing: Samples shall be at least 13 mm long and 30 cm wide with seam centered lengthwise. Five, 25 mm tests strips shall be cut from the trial weld. Each of the specimens shall be tested in the field for peel. A trial weld specimen shall pass when the results are achieved for peel tests with densitometer as per specifications/ Specified Value for this project . Remaining samples shall be retained for future testing (eg. external certified labs). For double wedge welding each weld shall be individually tested and both shall be required to pass in peel.

Seam property	Test method	requirement
Shear strength	Manual testing	Break in the sheet not in the weld
Peel strength	Manual testing	Break in the sheet not in the weld

3.4.3 ***Extrusion Welding*:** The weld area shall be prepared by sanding or grinding to a depth of less than 0.02 mm in the sheet surface to be in contact with the extrudate. Grinding required along a seam shall be done concurrent with or within twenty minutes of the seaming operation and shall not damage the geomembrane. Membrane shall be overlapped a minimum of 100 millimeters prior to seaming. The weld area shall be kept clean and dry during this process. Installer shall determine when preheating of the area to be seamed is required.

Adjacent panels shall be tack bonded together using procedures that do not damage the geomembrane, allow required tests to be performed, and are not detrimental to final seaming. Welding apparatus shall be free of heat-degraded extrudate before welding. The geomembrane surface shall be abraded to a maximum ¼ inch beyond the weld bead area, using a disc grinder, or equivalent, not more than ½ hour before welding. The top edges of geomembrane 60 mil or greater shall be beveled 45deg C using a hand held grinder. The ends of all seams, which are more than five minutes old, shall be ground when restarting the weld. Grinding depth shall not exceed ten percent of the liner thickness.

Extrusion welding entails placing a hot extrudate on top of the preheated lap of two adjoining panels while simultaneously applying pressure, and utilizes a welding rod made from the same type of resin as the membrane. The welding rod is melted inside the extrusion welding machine to form the hot extrudate. Preheating of the sheet in the weld area is performed by the extrusion welding machine.

The Teflon shoe (that determines the profile of the molten extrudate) is checked for correct dimensions. The temperature controllers are then set to appropriate temperatures and the machines are allowed to heat to the machine temperature set point.

When the seam area is prepared, the welding machine is positioned so the nozzle and the shoe are flat on the seam. As the machine is moved forward, care is taken to assure that the point of the preheat nozzle is centered on the edge of the top sheet and is as close to the sheet as possible.

As the welding progresses, the welding operator takes care to assure correct machine speed and alignment.

3.4.4 Cross-seams: The top and bottom excess overlap shall be removed and the top and bottom edge of the cross seam shall be ground to a smooth transition prior to seaming. If the cross seam is welded by means of fusion apparatus, the cross seams shall still be cut back to the edge of the fusion weld and have a bead of extrusion applied 100 millimeters in all directions from the confluence of the two seams to form a "T". Seams shall run parallel to the slope.

3.4.5 Cold Weather Seaming

Welding can be completed in colder temperatures provided some additional guidelines are followed and the trail welds be performed in the same environment as the main production seams. The trial welds are very important, as they will verify that the welding equipment has been properly set to meet the site conditions. Below are some of additional guidelines to follow for the various temperature ranges. The onsite superintendent shall also have the experience to determine whether or not satisfactory seams can be achieved given the weather and site conditions and what steps need to be taken in order to obtain a satisfactory seam. Temperatures between 0°C and -10 °C: The welding procedure is the same as warm weather procedures other than making slight adjustments to the welding units' temperature and/or speed. When the weather is clear and sunny and the wind is minimal, only very slight adjustments are required, but when it

is cloudy, windy and cooler considerable adjustments may be required. Temperatures between -10°C and -20°C +: Additional care must be taken to ensure that the welding units are operating properly in the cold and that the welding temperatures and speeds are adjusted to accommodate the colder temperatures. During the seaming operation, the technician will monitor the welding unit to ensure that the set welding speeds and temperatures are maintained throughout the length of the seam. Depending on the weather conditions (cloudy, windy, frosty, etc.) the seam area may require preheating, with space heaters or hot air guns, to ensure a satisfactory weld is obtained.. No welding can take place when it is raining; sleeting, snowing or moisture of any type is present. Extra care must be taken when working on a wet, icy or snowy liner, as the liner becomes very slippery under these conditions. Removal of snow & ice can be completed using rubber tired snow blowers and plastic shovels.

Chapter 4.0: Quality Control

4.1 Site Test Equipment

The Installer shall maintain onsite, in good working order, the following items:

4.1.1 *Field Tensiometer:* The tensile tester shall be a load certified motor driven unit and have jaws capable of traveling at a measured rate of 50 millimeters/min. The tensile tester shall be equipped with a gauge which measures units of force exerted between the jaws. Certification of the unit shall have been performed within twelve months of the installation date.

4.1.1 *Vacuum Box:* The vacuum box shall consist of a rigid housing with a transparent viewing window on top and a soft, closed-cell neoprene gasket attached to the bottom of the housing. The housing shall be equipped with a bleed valve and a vacuum gauge capable of reading in tenths of a bar. A separate vacuum source shall be connected to the vacuum box such that a negative pressure can be created and maintained inside the box. A sudsy solution consisting of soap and water shall be dispensed on the seam immediately ahead of the vacuum box.

4.1.2 *Air Pressure Test Equipment:* This method shall apply only when the split hot wedge seaming method is used. Equipment shall consist of an air pump capable of generating and maintaining a positive pressure of between 1.5 to 2.0 bars. A manometer capable of reading up to 2.0 bars attached to a needle or nipple shall be used to pressurize the air channel in the seam

4.2 Non-Destructive Testing

4.2.1 Test Seams (Start-up): Test seams shall be made to verify that adequate conditions exist for field seaming to proceed. Each seaming apparatus shall produce a test seam at the beginning of each shift. In addition, if a seaming operation has been suspended for more than four hours or if a breakdown of the seaming equipment occurs, a test seam shall be produced prior to resumption of seaming operation. Test seams shall be made in the field on pieces of the approved geomembrane. Each test seam shall be at least 1.5 meters long by 300 millimeters wide for extrusion and 3 m long by 300 millimeters wide for fusion, with sufficient overlap for peel testing in the field tensiometer. Two samples 25 millimeters wide shall be taken from each end of the test seam using an approved template. The samples shall be tested in the field tensiometer, one from each end in peel and shear respectively. Samples tested in peel shall not fail in the seam. All test samples shall exhibit film tear bond and strength as defined under seam properties shown on page 10, table 1. If the seam fails, the seaming apparatus shall not be used for field seaming until any deficiencies have been corrected. This shall be verified by the production and successful testing of another test seam.

4.2.2 Vacuum Testing: All extrusion welded seams and "T" Seams shall be evaluated using vacuum box testing. A sudsy soap solution shall be applied to the test section and the vacuum box placed over the section. The bleed valve is the closed and the vacuum valve opened. The vacuum box shall maintain at least 0.2 bar vacuum during the test. Once a tight seal has been established, the test section shall be visually examined for a period of not less than 10 seconds to determine whether bubbling of the soapy solution at the seam is occurring. The vacuum box is then moved and the process is repeated on

the next adjacent section. A minimum of 25 millimeters overlap shall be provided between all test sections. All locations where bubbling of the sudsy solution is observed shall be clearly marked for repairs with a high visibility marker and recorded by number on field test reports. Any failed portion of seam shall be repaired and retested.

4.2.3 Air Pressure testing: Double wedge welded seams shall be sealed off at both ends. If the end of a seam will be an integral part of the geomembrane, the sealing shall be done in such a way that it does not harm the function of the geomembrane. The pressure feed device shall be inserted into the air channel at one end of the seam and pressurized to a minimum 2.0 bars. The feed valve shall be closed and the pressure sustained for a period of not less than 60 seconds. The pressure shall then be released by slitting the air channel at the opposite end of the seam. The Inspector shall observe the drop in pressure on the manometer to verify the continuity of the air channel. If a pressure loss of greater than 0.2 bars is observed or if the required pressure cannot be reached, then the seam shall be rejected, and shall be either reconstructed in its entirety or the leak located and patched. The entire seam shall then be retested according to the procedure outlined above.

- Nondestructive air pressure testing of fusion welded seams shall conform to the following parameters:

Maximum Acceptable Pressure and Pressure Loss : **Table : 1**

	HDPE		LLDPE	
Thickness	Max. Pressure	Allowable Loss	Max. Pressure	Allowable Loss
20-mil	20 psi	5 psi	20 psi	5 psi
30-mil	25 psi	5 psi	25 psi	5 psi
40-mil	30 psi	4 psi	30 psi	4 psi
60-mil	30 psi	3 psi	30 psi	3 psi
80-mil	35 psi	2 psi	35 psi	2 psi
100-mil	35 psi	2 psi	35 psi	2 psi

4.2.4 For spark testing, a conductive geomembrane is required. The procedure for this method will be ASTM D 7240, unless otherwise approved by the Owner/engineer.

All seams shall be non-destructively tested by the Installer over their full length to verify the integrity of the seam. Non-destructive testing shall be performed concurrently with field seaming. All non-destructive testing shall be observed and documented by the Inspector.

Approved non-destructive testing procedure is as above. Alternate procedures shall be submitted for approval to the Owner or his Representative prior to the commencement of non-destructive testing.

4.3 Destructive Testing

4.3.1 Destructive testing of field seam shall be performed at selected locations in order to verify seaming properties. All sampling and testing shall be done concurrently with field seaming so that verification of field seam properties is made as the work progresses and corrective action implemented, if necessary.

- Test samples shall be taken at an average frequency of one test location per 150 meters of seam. Sample locations shall be determined by the Inspector taking into consideration the difficulty of subsequent repair and testing. The Installer shall not be informed in advance of the locations where the seam samples will be taken.

- Samples shall be cut by the Installer under the direction of the Inspector. Each sample shall be indelibly numbered and identified. The sample number and location shall be recorded by the Inspector.
- The Engineer or Inspector may decrease or increase the amount of destructive testing based on the results of previous testing. Additional samples may also be required when the

Engineer or Inspector have reason to suspect the presence of excess crystallinity, contamination, faulty seam quality.

- The test sample shall measure approximately 300 millimeters wide by 1.0 meter long with seam entered lengthwise along the sample. Ten 2.5 cm wide sample strips shall be tested in the presence of the Engineer in the inspector tensiometer, 5 in peel and 5 in shear and shall meet the criteria listed below. The remainder of the sample and all test strips shall remain the property of the Owner.

Table 2

- HDPE Minimum Acceptable Strength

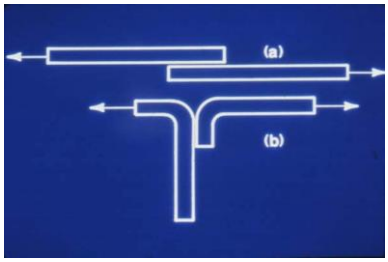
Thickness	Shear Strength (lbs / in. width)	Peel Adhesion Strength (lbs / in. width)	
		Wedge Weld	Extrusion Weld
0.75 mm (30-mil)	57	45	40
1.0 mm (40-mil)	80	55	45
1.5 mm 60-mil	120	80	72
2.0 mm 80-mil	160	110	90
2.5 mm 100-mil	200	135	120
3.0 mm 120-mil	240	160	140

Table 3

- LLDPE Minimum Acceptable Strength

Thickness	Shear Strength (lbs / in. width)	Peel Adhesion Strength (lbs / in. width)	
		Wedge Weld	Extrusion Weld
1.0 mm (40-mil)	44	40	40
1.5 mm 60-mil	66	60	60
2.0 mm 80-mil	88	75	70
2.5 mm 100-mil	110	94	88

Notes:
- Also for hot air and ultrasonic seaming methods
- Value listed for shear and peel strengths are for 4 out of 5 test specimen; the 5th specimen can be as low as 80% of the listed values



Picture 10: ***a:*** *shear test* ***b:*** *peel test*

- The Owner, at his option, may send the remaining sample to a lab of his choice for further destructive testing and approval. In any event, the samples shall not be considered to pass the test until the Engineer and Inspector are satisfied that the meet the seam pass/fail criteria of film tear bond and minimum seam properties.

- The area from which the destructive test sample was taken shall be repaired without delay and shall be non-destructively tested by vacuum box .

4.4 Inspection and Acceptance

- As the work progresses, the Inspector shall document all locations requiring repair work

and shall verify and document that all repairs have been successfully made by the Installer. No work on the liner shall be allowed if the inspector is not present. This is to include start-up tests, general seaming and patching, and any work at penetrations or structures.

- Seams are only considered to be accepted after they have passed the specified non-destructive and destructive tests, and the equipment used to produce the seams have passed the required start-up tests. If a seam fails the above criteria, the Installer must reconstruct the seam.

- The entire geomembrane surface shall be examined by the Inspector to confirm that it is free of any defects, holes, blisters, undispersed raw materials, or contamination by foreign matter. The geomembrane surface shall be cleaned by the Installer, if required, so that it is free of dust, mud, debris or any other material which may inhibit a thorough examination of the surface. Any suspect areas shall be clearly marked by the Inspector and non-destructively tested according to the appropriate specified testing procedure.

- Overburden shall not be applied to any portion of the liner system until that portion system is inspected by the contractor and the engineer and all documents affecting that portion have been approved.

Chapter 5.0: Installation Defects and Repairing .

The geomembrane shall be inspected for defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. The geomembrane surface shall be clean at the time of examination. Each suspect location shall be repaired and non-destructively tested. Geomembrane shall not be covered at locations that have not been repaired.

5.1 Assessment

Each suspect location in seam and non seam-areas shall be non-destructively tested as appropriate in the presence of the inspector. Each location that fails the non- destructive testing shall be marked by the inspector, and repaired accordingly.

5.2 Repair procedure

- Defect seams shall be cap stripped or replaced.
- Small holes shall be repaired by extrusion welding. If the hole is larger than 5 mm, it shall be patched.
- Tears shall be repaired by patching. Where the tear is on a slope or an area of stress and has a sharp end it must be rounded prior to patching. The ends of all cuts shall be rounded.

Picture 11: Repair procedure

- Blisters, large cuts and undispered raw materials shall be repaired by patches.
- Patches shall be fixed by extrusion welding. The weld area shall be cleaned no more than 10 minutes before the repair. No more than 10 % of the thickness shall be removed by grinding. Welding shall commerce where the grinding started and must overlap the previous seam without regrinding. The welding shall restart by grinding the existing seam and rewelding a new seam. All ground areas shall be covered by the patch.
- Patches shall be round or oval in shape, made of the same geomembrane (type and thickness), and extend a minimum of 150 mm beyond the edge of defect.

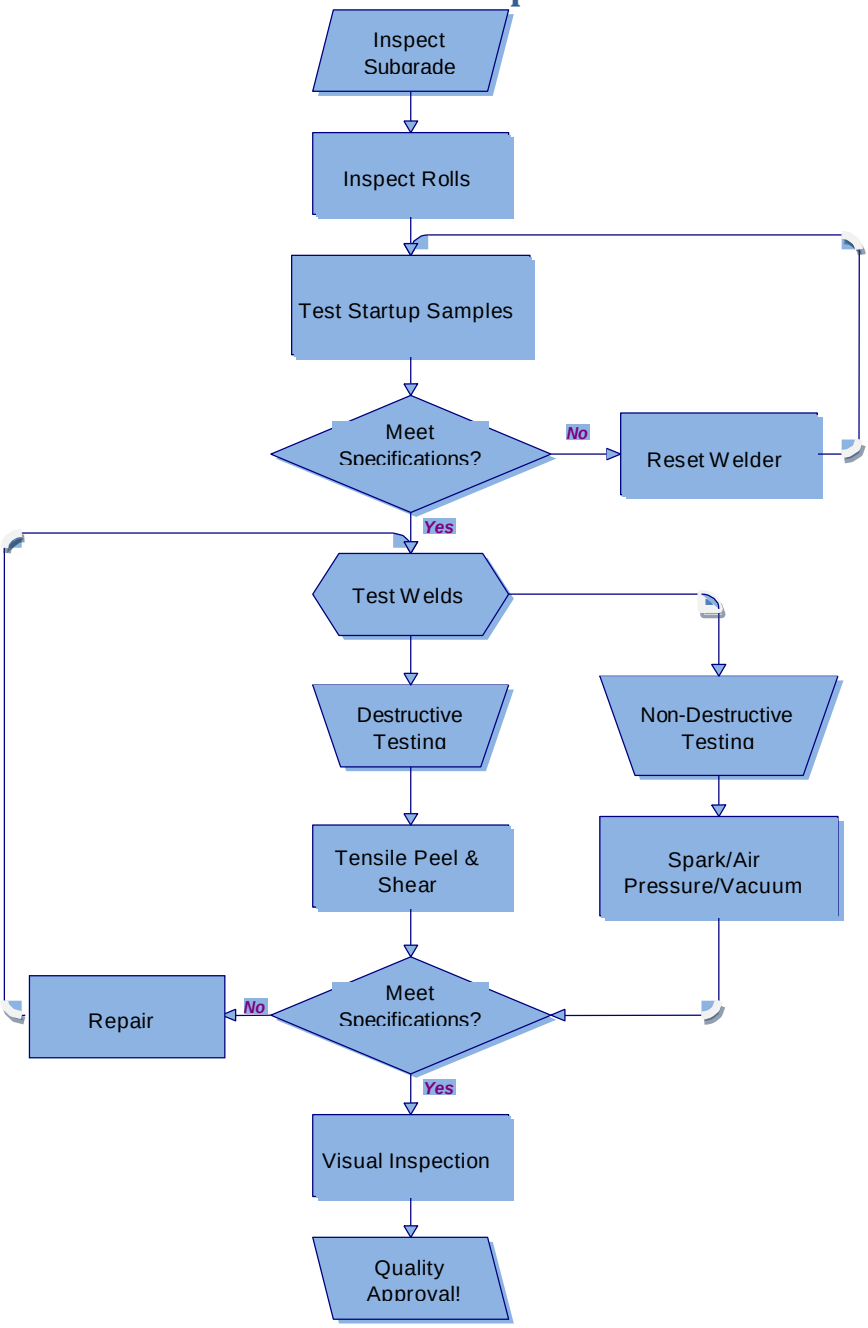
5.3 Testing of repairs (patches)

Each repair shall be non-destructively tested. Repairs that pass the non-destructive test shall be taken as an indication of an adequate repair. Failed tests indicate that the repair shall be repeated and retested until passing test results are achieved.

Chapter 6.0: Geomembrane Installation Acceptance Flow chart

Installer shall retain all ownership and responsibility for the geomembrane until final acceptance by the owner. Owner will accept the geomembrane installation when the installation is complete and verification of the adequacy of all field seams and repairs, including associated testing, is complete.

Installation Acceptance *Flow chart*



Chapter 7.0: Field Installation Daily reports & Documents

7.1 Daily Reports:-

Daily documentation of all non-destructive and destructive testing shall be provided to the inspector by the installer.

This documentation shall identify all seams including those that initially failed the test and include evidence that these seams were repaired and successfully retested.

Required Reports shall be as below:

Total amount and location of geomembrane placed per day and in total

Total length and location of seams completed, name of technicians doing seaming and welding unit numbers

Drawing of the previous day's installed geomembrane showing panel numbers, seam numbers and location of non-destructive and destructive testing (with **M/S Megaplast** roll numbers)

Results of pre-qualification test-seams.

Results of non-destructive testing.

Results of vacuum testing of repairs.

7.2 Documents

Attached in Annexures are documents as an example. These documents can be used by the geomembrane installer. These documents are only a recommendation to get a high quality documentation on site. For some projects an "as installed" plan may be required showing panel and seam number locations.

The following documents are required to confirm the completion of work:

Annexure “A” to Annexure “K”

Chapter 8.0: Completion of Work

8.1 Requirements

The installation of the geomembrane shall be considered totally complete when all required deployment, seaming, repairs, testing and site clean-up, including sand bags have been completed by the Installer; the Installer has submitted all the required certifications to the Owner; and the Owner and/or his Representative is satisfied that the geomembrane has been installed in accordance with the above Specifications.

8.2 Installation Warranty

The Installer shall guarantee the HDPE / LLDPE membrane against defects in installation and workmanship for the period of one year commencing with the date of final acceptance of the liner system.

Annexure "A"

(Quality Control Documents Formats)

MEGAPLAST

MIPL/QA/INST/F/09

Inventory List

Project Name: _____

Project No.: _____ Date: _____

Project Location: _____ Page: _____ of ___

Material	Roll No.	Used details	Remarks		Material	Roll No.	Used details	Remarks

Signature of QC :/ Date

Signature of Site Representative: / Date

Annexure "B"

MEGAPLAST

MIPL/QA/INST/F/10

Inspection of Material

Project Name: _____.

Project No.: _____Date:_____

Type of Material: _____

Manufacturer: _____

Lot No.	Roll No.	Dimensions	Yes	Label No	General Condition

Signature of QC :/ Date

Signature of Site Representative: / Date

Annexure "C"

MEGAPLAST

MIPL/QA/INST/F/11

Certificate of Acceptance of Sub-Grade

Project Name: _____ Material: _____

Project No.: _____ Date: _____

Project Location: _____ Page _____of _____

Area to be accepted:

_____

_____

_____

_____

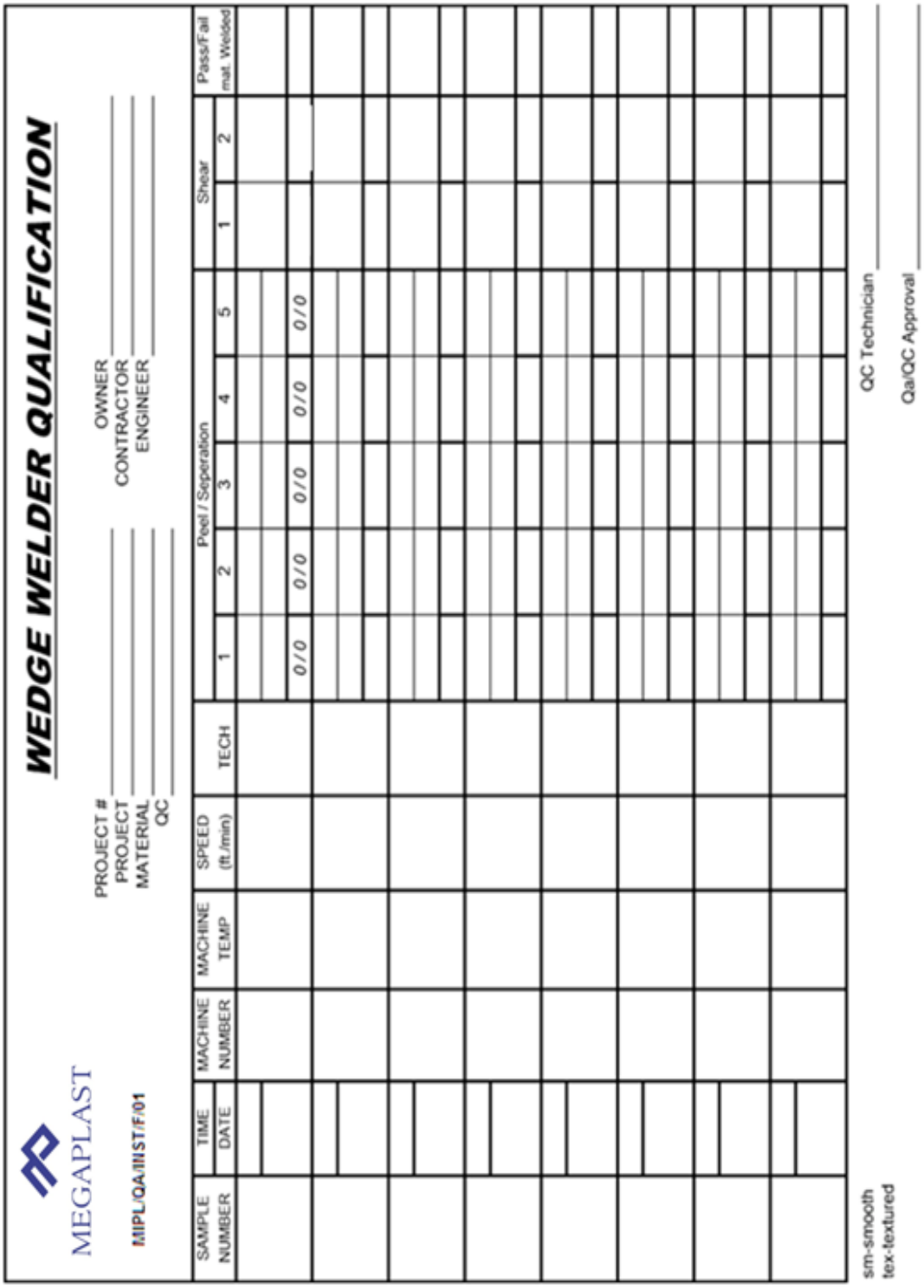
_____

I, the undersigned, do hereby accept the surface condition for the deployment of the HDPE/ LLDPE liner.

Signature of QC :/ Date

Signature of Site Representative :/ Date

Annexure “D”



WEDGE WELDER QUALIFICATION

MEGAPLAST

MIPL/QA/INST/F/01

PROJECT #
PROJECT
MATERIAL
QC

OWNER
CONTRACTOR
ENGINEER

SAMPLE NUMBER	TIME / DATE	MACHINE NUMBER	MACHINE TEMP	SPEED (ft./min)	TECH	Peel / Seperation 1	2	3	4	5	Shear 1	2	Pass/Fail mat. Welded
						0 / 0	0 / 0	0 / 0	0 / 0	0 / 0			

sm-smooth
tex-textured

QC Technician _____

Qa/QC Approval _____

Annexure "E"

MEGAPLAST

MIPL/QA/INST/F-02

EXTRUSION WELDER QUALIFICATION

PROJECT # _____
PROJECT _____
MATERIAL _____
QC _____

OWNER _____
CONTRACTOR _____
ENGINEER _____

SAMPLE NUMBER	DATE / TIME	MACHINE NUMBER	MACHINE TEMP	PREHEAT TEMP	TECH	Peel / Seperation 1	2	3	4	5	Shear 1	2	pass fail

QC Technician _____

QC Approval _____

Annexure “F”

PANEL PLACEMENT LOG

MEGAPLAST

MIPL/QA/INST/F-03

PROJECT # _____ OWNER _____
PROJECT _____ CONTRACTOR _____
MATERIAL _____ ENGINEER _____
QC _____

Panel Number	Roll Number	Installation Date	Dimensions (ft) length	Dimensions (ft) width	Area (sqft)
				Total	

QC Technician _____

QC Approval _____

Annexure "G"

MEGAPLAST

MIPL/QA/INST/F/04

Repair Log Sheet

Project Name: _____ Material: _____

Project No.: _____ Date: _____

Project Location: _____ Page: _____ of ___

Repair No.	Defect Code	Repair Date	Panels # Location	Time of repair	Repair Type	Approx. Dimensions	Repair Tech. Initials	Inspector	Vacuum Test Date	Vacuum Test P/F	Comments

BO---Burn out
T---Joint
EE---Earth equipment damage
VL---Vacuum test leak
WR--- Wrinkle
DS-#---Destructive test #

Repair Type:
C:Cap strip
P:Patches
B:Extrudate Bead

QC Technician _____

QC Approval _____

Annexure “H”

MEGAPLAST

MIPL/QA/IIST/F/05

Destructive Sample

PROJECT # ____________ OWNER ____________

PROJECT ____________ CONTRACTOR ____________

MATERIAL ____________ ENGINEER ____________

QC ____________

DT #	SEAM NUMBER	DATE WELDED	DATE TESTED	MACHINE NUMBER	TECH		Peel / Seperation 1	Peel / Seperation 2	Peel / Seperation 3	Peel / Seperation 4	Peel / Seperation 5	Shear / Elongation 1	Shear / Elongation 2	Shear / Elongation 3	Shear / Elongation 4	Shear / Elongation 5	pass/fail mat. Welded
						in											
						out											
						in											
						out											
						in											
						out											
						in											
						out											
						in											
						out											
						in											
						out											
						in											
						out											
						in											
						out											

sm-smooth
tex-textured

QC Technician ____________

QC Approval ____________

Annexure “I”

MEGAPLAST

Seam Pressure Testing Log

MIPL/QA/INST/F/06

PROJECT # ____________________

PROJECT ____________________

MATERIAL ____________________

QC ____________________

OWNER ____________________

CONTRACTOR ____________________

ENGINEER ____________________

Seam Number	Date Welded	Date Tested	Machine Number	Operator	Pressure (psi)		Time		QC Tech	Comments
					start	finish	start	finish		

QC Technician ____________________

QC Approval ____________________

Annexure "J"

MEGAPLAST

MIPL/QA/IIST/F/07

End Seam Sample Log

PROJECT # ____________ OWNER ____________
PROJECT ____________ CONTRACTOR ____________
MATERIAL ____________ ENGINEER ____________
QC ____________

Seam Number	Date Welded	Date Tested	Machine Number	Operator	Peel		Peel		Shear	QC	Comments (P,F)
					in	Out	in	Out			

QC Technician ____________

QC Approval ____________

Annexure "K"

MEGAPLAST

MIPL/QA/INST/F/08

Non-Destructive Testing

Project Name: _____

Project No.: _____ Date: _____

Project Location: _____ Page _____of _____

Material: _____ QC Engineer: _____

Seams				Air Pressure Test					Vacuum Box Test			
Seam	Trial	Tester Initials	Testing Date	Starting time	Starting Pressure	Ending time	Ending Pressure	Test duration	Starting time	Pressure	Pass / Fail	Remarks

QC Technician _____

QC Approval _____

"END "