

## General Specification for HDPE Liner

### 1. Scope of works

The scope of works covered by this specification is for the supply, installation and testing of a (thickness)mm, **High Density Polyethylene (HDPE)** geomembrane,

The scope of work includes the following items:

- Supply, Delivery and Installation of the Specified Premium Grade HDPE geomembrane liner.
- Provide all Administration, Management, Supervision, Labour and Equipment to perform the installation of the HDPE geomembrane lining to the manufacturers recommendations.
- Supply of all approved High Density Polyethylene geomembrane Welding and QA/QC testing equipment.
- Provision of QA/QC Certificates for Raw materials, Manufactured materials, Site works and Site Testing as detailed in this specification.
- Installation, Testing, submittals for approval and commissioning of all High Density Polyethylene geomembrane lining as detailed in this specification.

### 2. Experience

The Installer shall, at the time of tendering, provide evidence of his ability and experience to supply and install the specified HDPE geomembrane lining. The Installer at a minimum must have at least five (5) years continuous experience in the installation of HDPE sheet. Full details of experience must be lodged at the time of tender for approval by the Principal. Failure to demonstrate prior use and vast experience with the specified materials will be grounds for rejection of any tender.

## 3. Membrane Manufacturer and Supply

### 3.1 Material Specifications

The geomembrane shall be Premium Grade High Density Polyethylene or equivalent. The membrane shall be manufactured by flat-cast extrusion process only, and consist of single resin being one hundred percent Virgin and of a narrow molecular distribution. Carbon black shall be added to the Resin for ultraviolet resistance. The flexible membrane shall be manufactured to the following approximate ratios; HDPE 97.5% - Carbon Black 2.5%.

All membrane shall be provided in rolls of a minimum width of 6.8 metres. Each roll shall be labelled to provide the following identifying data:

- Name of manufacturer and type
- Material thickness
- Roll Number
- Roll Length
- Roll Weight
- Roll Width
- Cross reference numbers to Raw Material Batch and all Laboratory certified reports
- The manufacturers approved QA stamp and the technicians signature

The material shall be free from holes, blisters, folds, undispersed raw materials, and any sign of contamination by foreign matter.

Membrane material shall meet the requirements of the attached technical specifications.

### 3.2 QA/QC Requirement for Membrane Raw Materials

All raw material supplied to the manufacturer shall be delivered in rail car batches and must be supplied with test certification from the raw material supplier. The certification must state the results of tests which confirm the quality of the resin. The raw material supplier must also confirm that each batch of resin is all of the same type and is 100% Virgin. Each batch of resin shall be given an identification (batch) number and remain on file to keep track of all rolls manufactured from each batch.

The use of any off spec, recycled or blends of resins will not be considered.

Prior to the production of the membrane, the Membrane Manufacturer tests the raw material batches to certify that the raw material supplier test results identify the singular resin.

The Membrane Manufacturer shall provide certification and all available test results for raw materials prior to the delivery of materials to site.

### 3.3 QA/QC Requirements for Membrane Manufacturing

The manufacturing process shall be a fully automated Flat-Cast extrusion process controlled by a fully computerised system. The control system shall provide for the continuous monitoring of the following parameters; Temperature, Pressure and Speed.

The manufacturing process must also provide for the automated continuous monitoring of thickness and sheet quality.

**Thickness:** Each roll shall be tested automatically and evenly over its entire surface area. The minimum parameters acceptable for testing each roll shall be 6,000 thickness point checks. The acceptable thickness for each roll shall not be greater than – 10% of the specified material thickness.

**Sheet Quality:** Each roll shall be tested automatically High Voltage over its entire surface area for any point of Electrical Continuity through (across) the thickness of the sheet. The high voltage scanner shall be capable of detecting any pinhole, and void or significant reduction of the electrical resistance. Any roll detected to have holes or electrically conductive inclusions shall be rejected and not sent to the site.

Each roll delivered to site shall be provided with a roll test date report. These reports must provide the following information and test results as per the specified ASTM standards. Reports must also carry the manufacturers laboratory QA/QC approval seal.

## 4. Subgrade Preparation

All subgrade surfaces, over which the HDPE Flexible Membrane shall be placed, will be prepared as follows; New line area to be lined shall be smooth and free of stones, rocks, roots, sticks and any sharp objects or debris on any kind. The surface shall provide a firm unyielding uniform base for the membrane. The surface shall be compacted to a density to allow the movement of vehicles, welding equipment and personnel on it without causing rutting or other detrimental effect. The area to be lined shall not be effected by rising ground water, or ponding of water. The earthworks contractor shall complete the subgrade preparation to the approval of the lining contractor.

## 5. Installation of Flexible Membrane

The installer shall install the membrane as per the recommended methods of the Membrane Manufacturer. The membrane panel layout will be the responsibility of the Installers Site Manager, in conjunction with the Principals approval. Individual panels of membrane shall be overlapped with adjacent membrane sheets by a minimum of 50mm.

The membrane liner shall terminate within an anchor trench located .5 metre away from the top of the embankment. Once the membrane is in place the anchor trench must be backfilled and suitably compacted to prevent slippage of the membrane.

The Membrane Installer shall be responsible for making allowances considered necessary to accommodate variations in temperature and weather conditions.

## 6. Field welding of Flexiable Membrane

All welds require a minimum of 50mm overlap. Two types of welding methods shall be approved for this project.

### 6.1 Primary Welding Method

All primary welds shall utilise the Split Hot-Wedge Fusion welding method. The Split Hot-Wedge welder shall be a fully automated device comprising of a heated copper wedge, pressure rollers and electronic controls. The copper wedge shall be controlled and constantly monitored by a programmable controller with an audible off-temperature alarm and a variable speed drive unit. The copper wedge shall create two contact fusion areas of a minimum width of 10mm and a 2mm minimum wide void between each of the separate parallel weld zones. This void shall be created over the entire seam length to allow for field weld pressure testing.

### 6.2 Secondary Welding Method

All secondary welds shall utilise the manufacturers' surface Extrusion Hand Welders. The minimum width of the surface extruded bead shall be 15mm. The surface extrusion welder shall be semi-automated and equipped with electronic controls which constantly monitor outputs for both preheat and HDPE extrudate. The unit shall be capable of pre-heating the sheet just prior to the casting of HDPE extrudate over the upper and lower section of the weld zone.

The extrusion rod for the surface extruding welding shall be manufactured from the same resin type used in the manufacture of the membrane. All physical properties shall be identical to those possessed by the membrane raw material. The manufacturer shall provide certified test data with each batch of welding rod. All rod supplied shall be packed to prevent the ingress of moisture and other contaminates. If necessary the Installer shall also employ an apparatus specifically built for drying rod to ensure weld quality.

### 6.3 General Site Welding

The Installer shall be responsible for regularly checking, calibrating and recording the following items:-

- Preheat temperature at the nozzle
- Internal barrel temperature
- Split Copper wedge temperature
- Split Copper wedge speed.

## 6.4 Weld Preparation

The Installer shall ensure prior to any primary or secondary welding that weld zones be clean, free from moisture, dust, and any other foreign matter. All weld zone surfaces shall be either cleaned or abraded no more than 60 minutes prior to the commencement of welding any seam. In extremely bad conditions it may be necessary for the installer to clean and/or abrade the weld zone areas only minutes prior to the required weld.

## 6.5 Trial Welds

Trial welds shall be made on fragment pieces of membrane to verify that welding machine parameters are set to produce satisfactory welds. Such trial welds shall be made prior to actual field welds at the beginning of each working day. Samples shall be cut from the trial weld using a calibrated die cutter and tested on a calibrated tensiometer in shear and peel to determine whether the test welds have passed or failed.

# 7. Testing of wedge fusion weld

***Destructive Testing*** – Prior to actual field welding, the machine technician will run trial welds on fragment pieces of membrane. Such trial welds shall be made at the beginning of each working day. The trial weld sample shall be at a minimum 1.0m long by 0.3m wide with the weld centered lengthways. Four 25mm wide samples shall be cut from the trial weld sample using a calibrated die cutter. Test will be in shear and peel using a calibrated tensiometer to determine whether the test welds have passed.

Destructive seam tests shall also be performed at random selected locations during the installation by the Principal and Installer, at a minimum of one sample every 300m. The purpose of these tests shall be to confirm and evaluate seam strength and continuity during the field seaming. Each sample shall be cut using a calibrated die cutter into two 25mm wide pieces and shall be tested in shear and peel.

In the event of a failure, all prior welds shall be tested back to the last test which passed. It will be the responsibility of the Installer to repair and make good the seam/seams to the satisfaction of the Principal.

***Non-Destructive Testing:*** - 100% of all wedge welds will be tested. The air pressure testing kit required, shall be an apparatus consisting of a hollow needle attached to a pressure gauge and air fitting. Air pressure can generally be provided by manual or mechanical pumps. The testing unit shall be capable of withstanding and maintaining pressures between 20 to 45 PSI.

The following procedure for air channel testing shall be followed:

- a. Seal both ends of the seam to be tested.
- b. Insert needle into the channel created by the wedge welder.
- c. Connect air pump and pressurize the channel to a minimum of 20PSI and maintain the pressure for approximately two (2) minutes
- d. If loss of pressure exceeds 10% or does not stabilize, locate faulty area, repair with surface extrusion weld and re-test seam.
- e. Remove the APT kit.

## 7.1 Testing of Surface Extrusion Welding

**Destructive Testing:** - Prior to actual field welding, the Machine Technician will run trial welds on fragment pieces of membrane. Such trial welds shall be made at the beginning of each welding period. The trial weld sample shall be at a minimum .5mm long by 0.3m wide with the weld centered lengthways.

Four 25mm wide samples shall be cut from the trial weld sample and tested in shear and peel using a field tensile tester to determine whether the test welds have passed.

**Non-Destructive Testing:** - 100% of all surface extrusion welds will be tested. The High Voltage Spark Gun unit required for testing will be supplied by installer.

The procedure for High Voltage Spark Testing shall be as follows:-

- a. Area of well must be clean and dry.
- b. Patch is to be heat tacked firm
- c. Overlap of area to be abraded (min 10mm)
- d. Copper wire to be inserted at overlap of material
- e. Surface weld to be carried out
- f. Allow to cool
- g. Point H.V.S.T at weld moving slowly over welded area
- h. If a spark shows repair and retest.

## 8. QA/QC Certificates and records for material and installation

The installer shall provide the Principal with the following listed Test Certificates and Records prior to, during and/or at the completion of the works as each report and record is required.

- Certification and Test results of Raw Materials from Raw Materials Supplier
- Certification and Test results of Raw Materials from Membrane Manufacturer
- Roll Test Data Reports for Each Roll of Material
- HDPE Welding rod Test Reports
- Daily Installation Reports for each welder and technician:-
  - Trial Test weld Record
  - Wedge Weld Records
  - Surface Extrusion Weld Records
  - Weld Peel and Tensile Test Records
  - Wedge Air Channel Pressure Test Records
  - Patch, Repair and HVT Records
- Completed as Built Drawing, including roll numbers, panel layout, seam locations and repair locations.

## 9. Independent testing

The Principal at his own discretion and cost may require the Installer to extract random samples of sheet from each roll and from welded seams to qualify the Manufacturers and Installers test results. Samples shall be kept to a minimum and the following frequency of samples shall apply:

- Material samples = 1 – sample per roll
- Weld Samples from Site – 1 sample for every 300 metres, of seam.

All subsequent independent tests shall be undertaken by an approved testing authority experienced in the testing and evaluation of HDPE Flexible Membrane liners. The tests and results shall be subject to review and/or confirmation by the Membrane Manufacturer.

- **Roll identification and dimensions**

- Roll number
- Production Date
- Area of Sheet on Roll\
- Roll Length
- Roll Width
- Roll Weight

- **Resin lot information**

Batch Number

Resin Type

Resin Test Results –

ASTM

Density	D792
Moisture	D570
Brittleness	D746
Melt Index	D1238
O.I.T.	D3895

- **MEMBRANE PROPERTY, ASTM METHOD, MINIMUM SPECS AND ROLL REST VALUES FOR THE FOLLOWING:**

	<u>ASTM</u>
Carbon Black Dispersion	D3015
Carbon Black Content	D1603
Geomembrane Density	D792
ESCR	D1693-B
Thickness – Normal	D1593/D751
Minimum	
Ave. Thickness	
Puncture Resistance (Strength)	FTMS 101/2065

The following items shall be tested in both machine and cross direction:

	<u>ASTM</u>
Tensile Yield Strength	D638
Yield Elongation	D638
Tensile Break Strength	D638
Break Elongation	D638
Tensile Impact Strength	D1822
Tensile Impact Elongation	D1822
Tear Resistance	D1004
Dimensional Stability	D1204

Any material rejected on site by the Principal shall be jointly inspected by the Principal, the installer and the manufacturer. If required, the material shall be tested, and if the material is unable to meet the specification, it shall be replaced by the manufacturer/installer at his cost.

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