1.0 GENERAL

1.1 REFERENCES

.1 Provide Polyvinyl Chloride (PVC) lining in accordance with the following standards (latest revision) except where specified otherwise.

.2 American Society for Testing and Materials (ASTM)

.1	ASTM D374	Standard Test Methods for Thickness of Solid Electrical Insulation.
.2	ASTM D882	Standard Test Method for Tensile Properties of Thin Plastic Sheeting.
.3	ASTM D1004	Standard Test Method for Initial Tear Resistance of Plastic Film and Sheeting.
.4	ASTM D1203	Standard Test Method for Volatile Loss From Plastics Using Activated Carbon Methods.
.5	ASTM D1204	Standard Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature.
.6	ASTM D1239	Standard Test Method for Resistance of Plastic Films to Extraction by Chemicals.
.7	ASTM D1755	Standard Test Method for Poly (Vinyl Chloride) Resins.
.8	ASTM D1790	Standard Test Method for Brittleness Temperature of Plastic Sheeting by Impact.
.9	ASTM D1876	Standard Test Method for Peel Resistance of Adhesives (T-Peel Test).
.10	ASTM D3083	Specification for Flexible Poly (Vinyl Chloride) Plastic Sheeting for Pond, Canal, and Reservoir Lining.
.11	ASTM D4437	Standard Practice for Determining the Integrity of Field Seams Used in Joining Flexible Polymeric Sheet Geomembranes.

1.2 SUBMITTALS

.1 Provide the following submittals.

.2 Samples:

.1 Label, package, and deliver samples to the following testing laboratory:

[Company Name, Contact Name, and Address]

.2 One sample of sheeting material, [2500 mm by 1500 mm, for each 10000 m^2] of sheeting manufactured 20 days prior to fabricating the lining. Mark each sample with the roll number from which it was taken, and identify the direction of travel of the sheet during the manufacturing process.

.3 One sample of fabricated lining [500 mm by the width for every third section] of lining fabricated, 30 days prior to delivery to the Site. Include identification of the lining section from which the sample was removed.

.3 Product Data:

.1 The results of quality control tests performed for determining the physical properties by the sheeting manufacturer at least 20 days prior to commencing lining fabrication.

.2 The results of quality control tests for determining the physical properties performed by the lining fabricator at least 30 days prior to delivering any lining to the Site.

.3 The procedure for completing factory seams at least 20 days prior to commencing the lining fabrication including results of seam peel strength tests.

1.3 QUALITY CONTROL

.1 Have the sheeting manufacturer and the lining fabricator perform quality control tests to verify that the PVC lining and seams meet or exceed the physical properties specified.

1.4 QUALITY ASSURANCE

.1 Provide the Minister with access to the plants for performing inspections during lining fabrication. Notify the Minister at least 2 days prior to fabrication.

.2 The Minister may conduct tests on the samples provided by the Contractor. The actual number of samples that will be tested will be determined by the Minister.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Package and transport manufactured sheeting and fabricated lining using means that prevent damage.

.2 Inspect each shipment of material and timely replace any damaged materials.

.3 Unload, handle, and store PVC lining in accordance with the manufacturer's and the fabricator's instructions.

2.0 PRODUCTS

2.1 PVC LINING - GENERAL

.1 Provide PVC sheeting compound that is premium quality homopolymer vinyl chloride resin Type GP in accordance with ASTM D1755, Section 8.02, and formulated to impart durability. Use ingredients that are not water soluble, and are biologically inert in their effects on plants, animals, and humans. Include plasticizers that are resistant to migration, fungi, algae, and bacterial degradation, and containing sufficient stabilizers in the formulation to prevent any degradation of the material during processing or subsequent sheet seaming. Use no more than 2% by weight of well dispersed pigment to produce a uniform black or grey coloured lining that remains opaque when viewed on a light table.

2.2 PHYSICAL PROPERTIES

.1 Provide PVC sheeting with the following or better physical properties:

Property	Requirement	Test Method
.1 Thickness	0.52 $\pm$ 0.04 mm	Method C, ASTM D374, Section 8.01
.2 Minimum sheet width	1.50 $\pm$ 0.02 m	
.3 Minimum tensile strength:		
.1 Longitudinal direction	14 MPa	Method A
.2 Transverse direction	14 MPa	ASTM D882, Section 8.01
.4 Minimum bonded seam strength:		Method A, ASTM D882, Section 8.01
.1 Longitudinal and transverse direction	90% of the specified minimum tensile strength for the material	
.5 Minimum seam peel strength	3.0 N/mm of width	ASTM D1876, Section 8.02, modified*
.6 Minimum % elongation at break:		Method A ASTM D882, Section 8.01
.1 Longitudinal direction	300%	
.2 Transverse direction	300%	
.7 Pinholes and cracks/10 m^2	Maximum 1	Section 9.4, ASTM D3083, Section 8.02
.8 Resistance to soil burial, maximum % change in either the longitudinal or transverse direction (procedure only):		Section 9.5, ASTM D3083, Section 8.02
.1 Tensile strength	5%	
.2 Elongation	20%	
.3 Modulus at 100% elongation	20%	

Property	Requirement	Test Method
.9 Water extraction, maximum % weight loss	0.35%	Section 9.6, ASTM D3083, Section 8.02, ASTM D1239, Section 8.01
.10 Minimum tear resistance:		ASTM D1004, Section 8.01
.1 Longitudinal direction	35 N/mm	
.2 Transverse direction	35 N/mm	
.11 Impact resistance –20 ± –0.5°C	Not more than 2 of 10 specimens shall fail	Section 9.8, ASTM D3083, Section 8.02 ASTM D1790, Section 8.02
.12 Volatile loss maximum	0.9%	Method A, ASTM D1203, Section 8.01
.13 Maximum % shrinkage at elevated temperature	5%	Section 9.10, ASTM D3083, Section 8.02 ASTM D1204, Section 8.01

*The modifications to the ASTM D1876 seam peel strength test procedure may be obtained from Alberta Transportation

2.3 IDENTIFICATION

.1 The sheeting manufacturer is to assign a unique number to each roll of PVC sheeting produced.

.2 The lining fabricator is to:

.1 assign a unique number to each fabricated lining section;

.2 record the numbers of the manufactured sheeting rolls used to fabricate the lining section;

.3 mark the assigned number of each fabricated section at the 4 corners on both sides of the sheet; and

.4 package the lining material in the sequential order in which it was fabricated, and mark the assigned number of each fabricated section on the outside of the packaging.

2.4 MANUFACTURED SHEETING

.1 Provide manufactured sheeting having a smooth matte finish on both sides; is free of gels, streaks, particles or foreign matter, undispersed raw material, cold flow material, windows, or other manufacturing defects; free of holes, tears, scratches, cracks, creases, pits or blisters; and free of nicks and cuts on the edges.

2.5 FABRICATED LINING

.1 Fabricate factory seams using a minimum overlap of 20 mm.

.2 Obtain the Minister's authorization of the procedure for completing factory seams prior to commencing the lining fabrication. Do not use prepared adhesive tapes.

.3 Fabricate the lining with at least 3 factory seams within each panel of material in such a manner that the bonded portion of the seam is offset from the nearest edge of the sheeting material by a minimum of 5 mm. These factory seams will subsequently be used for the Seam Peel Strength testing.

.4 During lining fabrication, increase the length of every third section of lining being fabricated by a minimum of 500 mm in the direction of the factory seams. Remove the additional 500 mm from across the entire width of the lining section and submit it to the Minister. Include identification of the lining section from which the sample was removed.

.5 Fabricate the lining for fully lined canal sections, to allow installation as follows:

.1 Provide field seams at right angles to the longitudinal direction of the canal. Longitudinal field seaming of the lining is not permitted.

.2 Provide sufficient length to cover a minimum 25 m length of canal without requiring a field seam.

.3 Provide sufficient width to cover the lined portion of the canal. Add additional width for anchoring, plus at least [2000 mm] of slack to prevent the lining from becoming taut when covered.

.4 Size the lining to allow placing in a slack condition in longitudinal and transverse directions.

.6 Fabricate the lining for partially lined canal sections with cutoff curtains, to allow installation as follows:

.1 Provide field seams at right angles to the longitudinal direction of the canal. Longitudinal field seaming of the lining is not permitted.

.2 Provide sufficient length to cover a minimum 25 m length of trench without requiring a field seam.

.3 Provide sufficient width to cover the lined portion of the trench cross–section. Add width for temporary anchorage at the top of the trench, plus at least [500 mm] of slack to prevent the cutoff curtain from becoming taut when covered.

.4 Size the lining to allow placing in a slack condition in longitudinal and transverse directions.

.7 Fold the fabricated lining in an accordion fashion in both directions and package to minimize handling in the field.

3.0 EXECUTION

3.1 PREPARATION

.1 Remove water, snow, ice, and loose or other deleterious materials from the subgrade.

.2 Prepare the subgrade to the lines, grades, slopes, and elevations specified in the Contract Documents. Remove rock fragments having sharp projections, fill abrupt breaks, and remove protrusions exceeding 15 mm.

.3 Do not place PVC lining until the subgrade surfaces have been inspected by the Minister. Rectify any defects identified by the Minister.

3.2 INSTALLATION

.1 Install PVC lining at the locations, and to the lines, grades slopes, and elevations specified in the Contract Documents.

.2 Place lining only when the atmospheric temperature is above –5°C.

.3 When installing lining at atmospheric temperatures below +10°C, use hot-air guns or other sources of heat capable of heating the lining prior to performing the field seaming.

.4 Place the lining in a slack condition in both the longitudinal and transverse directions such that it will conform to the contour of the subgrade without becoming taut when covered with fill material.

.5 Begin the installation at the downstream end and progress in an upstream direction such that the downstream end of any one sheet will overlap on top of the adjoining sheet.

.6 Overlap field seams including any seams of patches or replacement lining, a minimum of [150 mm], and make the seam watertight using the manufacturer's written instructions.

.7 Provide field seams that have a bond strength of at least [60%] of the specified minimum tensile strength for the lining measured by Method A, ASTM D882, Section 8.01.

.8 Non-destructively test the entire length of field seams using the [Air Lance Test method in accordance with ASTM D4437].

.9 Anchor the upper ends of the lining along each side of the canal section or, in the case of partially lined sections, at the top of the canal bank and in the cutoff at the toe of the canal bank.

.10 Protect the lining from damage at all times. Do not allow any equipment to operate directly on the lining or on the gravel armour cover. Repair or replace lining damaged during installation or construction of subsequent Work.

END OF SECTION