INTRODUCTION TO SAMPLE SPECIFICATIONS

GSE is the world leader in providing geosynthetic lining solutions, products and services to satisfy the needs of domestic and international and public and private companies engaged in waste management, wastewater treatment, mining, aquaculture and other industrial activities.

Gundle/SLT Environmental, Inc., the parent company of GSE, is a corporation formed in July 1995 by the merger of Gundle Environmental Systems, Inc. and SLT Environmental, Inc. It is listed on the New York Stock Exchange under the symbol "GSE". The company's headquarters are located in Houston, Texas. GSE's Gundseal GCL clay lining manufacturing plant is located in Spearfish, South Dakota, USA. GSE's non-woven geotextile plant is located in Kingstree, South Carolina, USA. Other manufacturing facilities are located in Germany, the United Kingdom, Canada, Thailand and Egypt.

GSE is the leading worldwide manufacturer and supplier of high density polyethylene concrete embedment liner to provide concrete protection from mechanical damage and corrosive and erosive environments. GSE's concrete embedment liners meet the highest criteria in the industry. With a liner thickness range of 2.0 mm to 5.0 mm, project design requirements can be fulfilled using any product in this range.

CONCRETE EMBEDMENT LINER

PART 1: GENERAL

1.01 SECTION INCLUDES

A. Specifications and guidelines for MANUFACTURING high-density polyethylene embedment liners.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM)

1. D 1505 Test Method for Density of Plastics by the Density-Gradient Technique
2. D 1603 Test Method for Carbon Black in Olefin Plastics
3. D 5199 Standard Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes
4. D 5596 Standard Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics
5. D 6693 Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes
6. D 1204 Standard Test Method for Linear Dimensional Changes of Nongrid Thermoplastic Sheeting or Film at Elevated Temperature
7. D 696 Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30°C and 30°C With a Vitreous Silica Dilatometer
8. D 746 Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
9. D 570 Standard Test Method for Water Absorption of Plastics
10. E 96 Standard Test Method for Water Vapor Transmission of Material

1.03 POST AWARD AND SUBMITTALS

A. All work for and in connection with the installation of the lining, field seaming and welding joints shall be completed in strict conformity with all applicable instructions and recommendations of the liner manufacturer.

B. All surfaces in contact with corrosive or erosive environments or environments susceptible to mechanical damage shall be lined with GSE StudLiner as manufactured by GSE Lining Technology, Inc.

C. At the request of the Engineer, Pre-Caster or End User, samples, datasheets, installation instructions, etc will be provided.

D. Included with the shipment of liner, submit certified test reports that the liner and material are manufactured in accordance with standards specified herein.

1.04 QUALIFICATIONS

A. The HDPE liner specified in this section shall be furnished by a manufacturer who is fully experienced, reputable and qualified in the manufacturing of the materials. The manufacturer must at least 10 years of manufacturing experience.

B. Locking devices must be extruded to the sheet as a one step process.

C. Liner shall be GSE StudLiner as manufactured by GSE Lining Technology, Inc.

D. Liner shall be produced in the United States.

E. Liner shall be 8 feet in width.

F. Liner shall demonstrate a minimum pull-out strength of 14,000 psf.

PART 2: PRODUCT

2.01 ROLL DIMENSIONS

A. Embedment sheets shall be produced in rolls that are 8.0 ft (2.4 m) in width and a thickness range of 80 mils (2.0 mm) to 200 mils (5.0 mm) in thickness. Roll lengths vary according to thickness.

B. Locking studs of the same material as that of the liner shall be integrally extruded with the sheet. Stud spacing shall be on approximate 1.25 in (30 mm) centers, such that there are approximately 110 studs per square foot (1200 per square meter).

2.02 MATERIAL PROPERTIES

A. The material used in the embedment liner and in all welding strips shall be made from 97-98% virgin high density polyethylene and 2-3% carbon black or pigmentation for the purpose of an otherwise specified color.

B. Plasticizer shall not be added to the resin formulation.

C. Embedment sheet and welding strips shall be free of holes, pinholes, bubbles, blisters, excessive contamination by foreign matter, and nicks and cuts on roll edges.

D. The HDPE cap strips shall be made from HDPE, have good impact resistance and have an elongation sufficient to bridge up to 0.5 inch settling cracks.

E. Cap strips shall be approximately 4 inches wide or greater and shall be equivalent to that of the liner.

F. Material shall maintain a repairable state through it’s lifecycle by methods approved and recommended by the manufacturer.

G. Embedment sheets shall have the following physical properties when tested in accordance with Table 1.

H. Raw resin shall have the following properties when tested in accordance with Table 2.

Table 1: Material Properties

Property	Test Method	Nominal Value				Testing Frequency
Thickness, mm (mil)	ASTM D 5199	2.0 (80)	3.0 (120)	4.0 (160)	5.0 (200)	Every 5th roll
Density, g/cm^3	ASTM D 1505	0.94	0.94	0.94	0.94	1/100,000 ft^2
Tensile Properties Strength@Yield,lb/in^2 (MPa) Elongation @ Break, %	ASTM D 6693 Type IV, Dumbbell G.L.= 2.0in (50 mm)	 2,220 (15.31) 500	 2,220 (15.31) 500	 2,220 (15.31) 500	 2,220 (15.31) 500	1/100,000 ft^2
Carbon Black Content/ Pigment Content, % Black Liner Gray Liner	 ASTM D 1603, mod. ASTM D 5630, mod.	 2-3 1.5 – 2.5	 2-3 1.5 – 2.5	 2-3 1.5 – 2.5	 2-3 1.5 – 2.5	1/100,000 ft^2
Carbon Black Dispersion	ASTM D 5596	Note 2	Note 2	Note 2	Note 2	1/100,000 ft^2
Notched Constant Tensile Load, hours	ASTM D 5397	400	400	400	400	1/ formulation
Coefficient of Linear Thermal Expansion, per °C	ASTM D 696	1.20E-04	1.20E-04	1.20E-04	1.20E-04	1/ product
Low Temperature Brittleness, °C	ASTM D 746	-77	-77	-77	-77	1/ product
Dimensional Stability, % (each direction)	ASTM D 1204	$\pm$ 1.0	$\pm$ 1.0	$\pm$ 1.0	$\pm$ 1.0	1/ product
Water Absorption, %	ASTM D 570	<0.01	<0.01	<0.01	<0.01	1/ product
Water Vapor Transmission, (g/m^2/day)	ASTM E 96	0.1	0.1	0.1	0.1	1/ product
Stud Pull-Out Strength[1], lb/ft^2 (kN/m^2)		>14,000 (669.89)	>14,000 (669.89)	>14,000 (669.89)	>14,000 (669.89)	1/ product

Note 1: Concrete must have a compressive strength of at least 5,000 lb/in2 (34,500 kPa)
Note 2: Dispersion only applies to near spherical agglomerates. 9 of 10 views shall be Category 1 or 2. No more than 1 view for category 3.

Table 2: Raw Material Properties

Property	Test Method	Value	Testing Frequency
Density, g/cm3	ASTM D 1505	0.932	1/ resin lot
Melt Flow, g/10 min	ASTM D 1238 (190/2.16)	$\leq$ 1.0	1/ resin lot
OIT, minutes	ASTM D 3895 (1atm/200°C)	100	1/ formulation

2.03 MATERIAL SUPPLY

A. Embedment sheets shall be supplied in roll form, sheets, pre-fabricated tubes or panels.

B. Cap strips shall be supplied in 4 inch widths or greater.

2.04 MATERIAL HANDLING AND STORAGE

A. Materials are to be handled as to prevent damage.

B. The on-site storage location for geomembrane material, provided by the CONTRACTOR to protect the liner from punctures, abrasions and excessive dirt and moisture. Storage area should have the following characteristics:

1. level (no wooden pallets)
2. smooth
3. dry
4. protected from theft and vandalism