This specification is proprietary as it is written for a specific product and manufacturer. There are no known equivalent products. The specification is based on the manufacturer’s specification materials and has been reviewed by the lining manufacturer.

The moisture content of the concrete surfaces that this lining system is applied to is critical to successful installation of this lining system. During design activities, the specifier should consider what measures will be necessary to provide a relatively dry substrate for lining installation and avoid hydrostatic pressures behind the lining system throughout the useful life of the facility. High hydrostatic pressures can permeate the porous concrete and cause any lining system to delaminate. Where the protective lining system extends more than ten feet below the maximum groundwater level (including maximum seasonal level) the earth exposed faces of the concrete should be waterproofed to control hydrostatic water penetration.

Locations where the lining system is to be applied should be scheduled and described in paragraph 09800-3.09.

PART 1--GENERAL

1.01 DESCRIPTION

This Section specifies the installation of a fully adhered polyurethane and polyvinyl chloride (PVC) sheet lining system for prepared surfaces of concrete structures. Contractor to provide all materials, labor and equipment necessary to complete the lining work specified herein.

1.02 QUALITY ASSURANCE

A. REFERENCES:

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version...
associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

<table>
<thead>
<tr>
<th>Reference</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM D2369</td>
<td>Standard Test Method for Volatile Content of Coatings</td>
</tr>
<tr>
<td>ASTM D4138</td>
<td>L.R. Standard Test Methods for Measurement Dry Film Thickness of Protective Coating Systems by Destructive Means</td>
</tr>
<tr>
<td>ASTM D4262</td>
<td>L.R. Standard Test Method for pH of Chemically Cleaned or Acid Etched Concrete Surfaces</td>
</tr>
<tr>
<td>ASTM D4414</td>
<td>L.R. Standard Practice for Measurement - Wet Film Thickness by V Notch Gages</td>
</tr>
<tr>
<td>ASTM D4417</td>
<td>Field Measurement of Surface Profile of Blast Cleaned Steel</td>
</tr>
<tr>
<td>ASTM D4787</td>
<td>L.R. Standard Practice for Continuity Verification of Liquid or Sheet Linings Applied to. Concrete Substrates</td>
</tr>
<tr>
<td>ASTM D5162</td>
<td>L.R. Standard Practice for Discontinuity Testing of Nonconductive Protective Coating on Metallic Substrates</td>
</tr>
<tr>
<td>ASTM E337</td>
<td>L.R. Standard Practice Test Method for Measuring Humidity with a Psychrometer</td>
</tr>
<tr>
<td>NACE 6D-173</td>
<td>A Manual for Painter Safety</td>
</tr>
<tr>
<td>NACE 6F-163</td>
<td>Surface Preparation of Steel or Concrete Tank Interiors</td>
</tr>
<tr>
<td>NACE RP0288-88</td>
<td>Standard Recommended Practice, Inspection of Linings on Steel and Concrete</td>
</tr>
<tr>
<td>NACE RP0892-92</td>
<td>Standard Recommended Practice, Linings over Concrete in Immersion Service</td>
</tr>
<tr>
<td>NACE TPC2</td>
<td>Coatings and Linings for Immersion Service</td>
</tr>
<tr>
<td>SSPC-PA-3</td>
<td>Steel Structures Painting Council—PA-3: A Guide to Safety in Paint Application</td>
</tr>
<tr>
<td>SSPC-SP1</td>
<td>Steel Structures Painting Council—SP1: Solvent Cleaning</td>
</tr>
<tr>
<td>SSPC-SP2</td>
<td>Steel Structures Painting Council—SP2: Power Tool Cleaning</td>
</tr>
<tr>
<td>SSPC-VIS-I</td>
<td>Steel Structures Painting Council—VIS-I: Pictoral Surface Preparation Standards</td>
</tr>
</tbody>
</table>
B. TRAINING AND CERTIFICATION:

1. LINABOND MASTIC SYSTEM:

   a. The Contractor shall only provide personnel who have been trained by the lining manufacturer to perform lining system installation.

   b. One full day of training (one 8-hour session) shall be required for all Contractor personnel performing lining system work. All Contractor personnel receiving lining installation training shall be paid for their training time by the Contractor.

   c. After successful completion of training, each of the Contractor's personnel shall obtain a certificate evidencing completion of the training and authorizing them to install the lining system. Only those personnel who have received lining installation training and the appropriate certificate may be used by the Contractor to perform the lining system work.

   d. The Engineer may require removal of any Contractor personnel due to poor workmanship, non-compliance with installation requirements as specified herein, or failure to follow direction provided by the Engineer, at the Engineer's sole discretion and determination. The Contractor shall, at no additional cost to the Owner, promptly replace such individuals with other personnel who have been trained by the lining manufacturer.

   e. Lining application done under this specification shall be inspected by a representative of the lining manufacturer and shall be subject to inspection by the Engineer. All parts of the work shall be accessible to the lining manufacturer's representative and the Engineer. Defective work shall be corrected as directed by the lining manufacturer's representative and the Engineer.

1.03 SUBMITTALS

The following submittals shall be provided in accordance with Section 01300:

1. Blasting material proposed for use under this Section.

2. Proposed method(s) of repairing joint leaks.

3. Lining system materials and manufacturer's application instructions, including:

   a. Product Material Safety Data Sheets.

   b. Maximum storage life and storage requirements.
c. Mixing and proportioning requirements (as applicable).

d. Environmental requirements for application and worker safety, including ventilation, temperature range and humidity.

e. Curing time required to match job-site conditions.

4. Manufacturers documentation that the Contractor, or the subcontractor proposed for the lining installation, is licensed for the Linabond Mastic System.

5. Manufacturer’s certification of each applicator proposed for the lining installation.

PART 2--PRODUCTS

2.01 DELIVERY, STORAGE, AND HANDLING:

The Contractor shall store all materials only in area or areas designated solely for this purpose. Confine mixing, clean-up and associated operations, and storage of debris before disposal, to these areas. All materials shall be stored on pallets or similar storage/handling skids off the ground.

The Contractor shall mix all lining materials in an enclosed mixing area provided by the Contractor. This enclosed area shall protect the mixing operation and materials from direct sunlight, inclement weather, freezing, or other means of damage or contamination. The Contractor shall protect all other concrete and metallic surfaces and finishes from any spillage of material(s) within the mixing area.

Drain piping shall not be used for disposal of lining materials.

The Contractor shall take all precautions and implement all measures necessary to avert potential hazards associated with the lining system as described on the pertinent Material Safety Data Sheets or container labels.

Receipt, storage, and handling of materials shall be the responsibility of the Contractor.

1. Labels on all material containers must show the following information:

   a. Name or title of product.
   b. Federal Specification Number if applicable.
   c. Manufacturer’s batch number.
   d. Manufacturer’s name.
   e. Application and mixing instructions.
   f. Hazardous material identification label.
   g. Shelf life date.

2. All containers shall be clearly marked indicating any personnel safety hazards associated with the use of or exposure to the materials.
3. All materials shall be handled and stored to prevent damage or loss of label.

4. Do not use or retain contaminated, outdated, prematurely opened, diluted materials, or materials which have exceeded their shelf life.

2.02 MATERIALS

The lining system for this project is manufactured by Linabond, Inc., 12960 Bradley Avenue, Sylmar, California 91342. This is a proprietary specification.

2.03 LINING SYSTEM MATERIALS

The lining system shall consist of an epoxy polyurethane primer (depending upon moisture content of the substrate), a high solids polyurethane mastic joint sealant, a high-solids polyurethane seam material (Hi-mod mastic), a surface activator for a polyvinyl chloride (PVC) sheet, an extruded PVC sheet, and pre molded PVC corners.

The components of the lining system and their properties are as follows:

1. Primer shall be Linabond EP-30HS Primer (for ambient temperature application) for use in priming concrete substrates in accordance with the substrate moisture and pH ranges specified. The EP-30HS Primer has the following properties:

<table>
<thead>
<tr>
<th>Property</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mix Ratio</td>
<td>1:1</td>
</tr>
<tr>
<td>Elongation</td>
<td>35 percent</td>
</tr>
<tr>
<td>Tensile Strength</td>
<td>&gt; 2,000 psi</td>
</tr>
<tr>
<td>Weight/Gallon</td>
<td>9.6 pounds</td>
</tr>
<tr>
<td>Solids Content</td>
<td>72.6 percent</td>
</tr>
<tr>
<td>Viscosity</td>
<td>250 Centipoise</td>
</tr>
<tr>
<td>Pot Life</td>
<td>One hour</td>
</tr>
</tbody>
</table>

2. Polyurethane mastic shall be a high solids, low modulus, polyurethane mastic/joint sealant. The mastic shall be permanently flexible, non-flow, and resistant to weathering, aging, dilute acids (7 percent sulfuric acid solution, or acid conditions generating pH levels of 0.5), and dilute alkalis. The material shall adhere to the activated polyvinyl chloride liner and to the primed concrete surface and shall have a work life of up to 3 hours. The polyurethane mastic shall have the following properties:

<table>
<thead>
<tr>
<th>Property</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performance Properties</td>
<td>Non-flow (typical)</td>
</tr>
<tr>
<td>Hardness, Shore A</td>
<td>&gt;30</td>
</tr>
<tr>
<td>Non-volatile Content</td>
<td>&gt; 93 percent</td>
</tr>
<tr>
<td>Adhesion, ASTM C-920</td>
<td>&gt; 23 pli</td>
</tr>
<tr>
<td>Tensile, ASTM D-412</td>
<td>175 psi</td>
</tr>
</tbody>
</table>
### Property

<table>
<thead>
<tr>
<th>Property</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elongation, ASTM D-412</td>
<td>&gt; 300 percent</td>
</tr>
<tr>
<td>Maximum Usable Temperature</td>
<td>200°F</td>
</tr>
<tr>
<td>Minimum Usable Temperature</td>
<td>-40°F</td>
</tr>
<tr>
<td>Tack-free Time @ 75°F to 80°F</td>
<td>16 hours</td>
</tr>
</tbody>
</table>

3. Surface activator shall be Linabond CLA-2 surface activator. The surface activator is a rapid drying, impregnating vinyl resin providing cross-linking of the polyurethane mastic with the polyvinyl chloride sheet. The CLA-2 surface activator shall have the following properties:

<table>
<thead>
<tr>
<th>Property</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solids</td>
<td>8-19 percent</td>
</tr>
<tr>
<td>Color (Gardner)</td>
<td>Clear</td>
</tr>
<tr>
<td>Weight/Gallon</td>
<td>8 pounds</td>
</tr>
<tr>
<td>Surface Dry</td>
<td>10 minutes</td>
</tr>
</tbody>
</table>

4. Seam material (hi-mod mastic) shall be a plural component high-strength, acid-resistant hybrid urethane. The seam material shall have the following properties:

<table>
<thead>
<tr>
<th>Property</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Side A Viscosity, centipoise</td>
<td>1,000 cps</td>
</tr>
<tr>
<td>Side B Viscosity, centipoise</td>
<td>3,000 cps</td>
</tr>
<tr>
<td>Solids (by weight)</td>
<td>&gt;97%</td>
</tr>
<tr>
<td>Side A Specific Gravity</td>
<td>0.96</td>
</tr>
<tr>
<td>Side B Specific Gravity</td>
<td>1.2</td>
</tr>
<tr>
<td>Flash Point</td>
<td>550°F</td>
</tr>
<tr>
<td>Mix Ratio</td>
<td>1 to 1</td>
</tr>
<tr>
<td>Initial Cure Time</td>
<td>20 to 30 minutes</td>
</tr>
<tr>
<td>Tensile, ASTM D638</td>
<td>1,860 psi</td>
</tr>
<tr>
<td>Elongation, ASTM D638</td>
<td>1.9</td>
</tr>
</tbody>
</table>

5. Polyvinyl chloride (PVC) liner shall be Linabond PVC lining material. Lining material shall be a homogenous thermoplastic PVC sheet material of 30 mil uniform thickness with the following properties:

a. PVC liner shall be resistant to damage from long-term exposure to the following chemical solutions:

<table>
<thead>
<tr>
<th>Chemical solution</th>
<th>Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sulfuric acid</td>
<td>20 percent*</td>
</tr>
<tr>
<td>Sodium hydroxide</td>
<td>5 percent</td>
</tr>
<tr>
<td>Nitric acid</td>
<td>5 percent*</td>
</tr>
<tr>
<td>Ferric chloride</td>
<td>1 percent*</td>
</tr>
<tr>
<td>Sodium Hypochlorite</td>
<td>1 percent</td>
</tr>
</tbody>
</table>
Chemical solution                        Concentration
Soap                                      0.1 percent
Detergent (linear alkyl benzyl sulfonate or LAS) 0.1 percent
Bacteriological                           BOD not less than 700 ppm

*Volumetric percentages of concentrated C.P. grade reagents.

b. PVC liner shall have the following physical properties:

<table>
<thead>
<tr>
<th>Property</th>
<th>Initial value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tensile Strength</td>
<td>2,200 psi</td>
</tr>
<tr>
<td>Elongation at break</td>
<td>200 % min</td>
</tr>
</tbody>
</table>

*When tested at 77± 5°F.

6. The PVC lining shall be white in color.

PART 3--EXECUTION

3.01 SAFETY

Contractor shall comply with all current local, state, federal, and other applicable safety and health regulations.

The contractor shall provide compressed air breathing equipment for the hydro blast/sandblast operators in the wet well during blasting operations. The compressor shall be a breathing air compressor and be equipped with high-temperature and carbon monoxide alarms and shall use an in-line filter to remove moisture. All precautions listed in the submitted material safety data sheets shall be incorporated in the Contractor’s Accident Prevention Program.

At the completion of the job, all hazardous materials and waste are to be removed in accordance with local, state, and federal regulations.

3.02 THINNERS AND SOLVENTS

Only cleaning solvents approved by the lining manufacturer shall be used in this contract. Cleaning solutions acceptable for use with Linabond are methylethylketone, acetone, and lacquer thinner.

3.03 CONTROL OF AMBIENT CONDITIONS IN STRUCTURES TO BE LINED

The Contractor shall control ambient conditions in the structures to be lined, and provide protective enclosures during surface preparation, application, and curing, to meet the ambient conditions specified below. The Contractor shall continue to meet the ambient conditions throughout the lining system work.
The ambient condition requirements inside the channels and structures during all phases of lining system work shall be as follows:

1. Air temperature - no lower than 55 degrees F
2. Relative humidity - not higher than 90 percent
3. Substrate surface temperature - no lower than 50 degrees F, and at least 10 degrees F higher than dew point temperature
4. Substrate moisture content – not higher than 30 percent as measured using a Delmhoist Moisture Meter, Model “DP.”
5. No dust generation shall be allowed during this period

Contractor shall provide ventilation, isolation, any other measures necessary to perform the lining system work in each channel and structure to be lined.

3.04 REQUIREMENTS FOR CLEANING AND SURFACE PREPARATION

A. GENERAL:

The Contractor shall provide initial cleaning, substrate decontamination, and degreasing for the structures that have been exposed to wastewater, as specified in paragraph 3.04(C), herein.

All channels and structures to be lined, including previously exposed concrete and new concrete structures, shall receive surface preparation provided by the Contractor as specified in paragraph 3.04(D through G), herein.

B. GENERAL SURFACE PREPARATION REQUIREMENTS:

1. Used or spent blast abrasive shall not be reused on this project.
2. The compressed air used for blast cleaning shall be filtered and shall contain no condensed water and no oil. Moisture traps shall be cleaned at least once every four hours or more frequently as required to prevent moisture from entering the supply air to the abrasive blasting equipment.
3. Oil separators shall be installed just downstream of compressor discharge valves and at the discharge of the blast pot discharges. These shall be checked on the same frequency as the moisture traps as defined in item 2 above.
4. Regulators, gauges, filters, and separators shall be in use on all of the compressor air lines to blasting nozzles at all times during this work.
5. An air dryer or desiccant filter drying unit shall be installed which dries the compressed air prior to blast pot connections. This dryer shall be used and maintained for the duration of all surface preparation work.
6. The abrasive blast nozzles used shall be of the venturi or other high velocity type supplied with a minimum of 100 psig air pressure and sufficient volume to obtain the blast cleaning production rates and cleanliness specified herein.

7. The Contractor shall provide ventilation for airborne particulate evacuation (meeting all pertinent safety standards) to optimize visibility for both blast cleaning and inspection for the substrate during surface preparation work.

8. Ground fault interrupters shall be used on all electrical equipment used in the work.

9. If between final surface preparation work and lining application, contamination of the prepared and cleaned substrates occurs, or if the prepared substrates' appearance darkens or changes color, recleaning by waterblasting, reblasting and abrasive blast cleaning shall be provided by the Contractor at no additional cost until the specified degree of cleanliness is reclaimed.

10. The Contractor shall be responsible for dust control and for protection of mechanical, electrical, and all other equipment within the facilities during abrasive blasting activities as specified and as indicated.

C. SURFACE PREPARATION OF ALL CONCRETE SUBSTRATES:

1. The Contractor shall abrasive blast clean all concrete surfaces to produce a sound, clean substrate free of latence, surface contaminants, and loose materials.

2. The Contractor shall abrasive blast clean all concrete surfaces (new concrete, previously coated concrete, and concrete previously exposed to wastewater) to produce a minimum, uniform substrate anchor pattern or profile similar to 60 to 80 grit sand paper. The anchor pattern that results from blasting on previously coated concrete surfaces will likely be greater.

3. Should abrasive blast cleaning not remove degraded concrete, chipping or other abrading tools shall be used to remove the deteriorated concrete until a sound, clean substrate is achieved which is free of calcium sulfate, loose coarse or fine aggregate, latence, loose hydrated cement paste, and other substances detrimental to the lining system's adhesion or cure, as indicated by the Engineer. Abrasive blast cleaning and other means necessary shall be used by the Contractor to open up all air voids or "bugholes" to expose their complete perimeter. Leaving shelled over, hidden air voids beneath the exposed concrete surface will not be acceptable.

4. Acceptable surface preparation shall produce a concrete surface pH of 7.0 to 12.0 to be confirmed by surface pH testing as specified under
paragraph 3.06 herein. Acceptable surface preparation shall remove all concrete acid reaction materials.

5. Acceptable surface preparation shall result in a concrete substrate moisture content of less than 30 percent as measured using a Delmhoist Moisture Meter, model "DP", as specified in Paragraph 3.05.

6. Following inspection of the concrete surface preparation by the Contractor and release by the Engineer, thoroughly vacuum clean all concrete surfaces to be lined to remove all loose dust, dirt, and spent abrasive leaving a dust free, sound concrete substrate. All debris produced by blast cleaning shall be removed from the structures to be lined and disposed of by the Contractor. The Contractor shall again inspect and if specified conditions are met, the Engineer will release the substrate to allow commencement of lining system installation.

D. SURFACE PREPARATION OF BARE AND COATED METAL SUBSTRATES ONTO WHICH LINING SYSTEM WILL TERMINATE:

1. The concrete lining system will terminate onto metal substrates at various embeddings, and penetrations. All such surfaces shall be abrasive blast cleaned to remove all existing coatings, paints, dirt corrosion products, and other substances that would prevent the specified lining adhesion from being achieved. All metal surfaces shall be abrasive blast cleaned to a white metal blast in accordance with SSPC-5. All metal surfaces shall be cleaned to produce a minimum surface profile of 3.0 mils which is uniform.

2. Post Blast Cleaning: Once abrasive blast cleaning has been completed by the Contractor and released by the Engineer, the Contractor shall:
   a. Remove all traces of grit, dust, dirt, rust scale, friable material, loose corrosion products or embedded abrasives from substrate by vacuum cleaning prior to lining system application.
   b. Prevent contamination of the concrete or metal surfaces after blasting from workers' fingerprints, substances on workers' clothing, or from atmospheric conditions. If, after cleaning, contamination occurs, reblast and reclean to achieve specified substrate cleanliness.

3. Adjacent coatings not required to be removed shall be protected as specified and as indicated.

Once the Contractor has completed surface preparation, the Contractor shall identify all voids in the concrete surface that are deeper than 1/2" and/or wider (in any direction) than 2". The Contractor shall repair voids with a polymer modified cementitious repair mortar in accordance with Section 03300. Once the repair mortar has cured for a minimum of 7 days, its surface shall be abrasive blast cleaned as specified above. Alternately, additional mastic (either Hi-Mod or Low-Mod) may be used to fill such voids and no sandblasting will be required. Mastic
shall be used to fill all voids and irregularities in the surface profile that are less than 1/2-inch deep and/or narrower than 2 inches.

3.05 INSTALLATION OF LINING SYSTEM

The Contractor shall be responsible for obtaining the services of a qualified and authorized representative of the manufacturer of the protective lining system to provide continuous field inspection, instruction, and direction to the lining Contractor during all the installation of the protective lining system to insure that the work, including but not limited to, the surface preparation, mixing and drying times and application procedures, are performed per the manufacturers recommendations.

A. The lining system shall provide a sealed membrane to prevent penetration of H₂S gas, other gases, and liquids to the substrate.

B. Termination of the lining system at leading edges (below the water line) and at all metallic interruptions to the concrete substrate, (pipe supports, pipe penetrations, gates to adjacent structures, tanks, and channels, etc.) shall be installed as indicated in the details, included in the contract drawings.

C. Primer shall be brush or roller applied to the prepared concrete surface previously exposed to wastewater, at a rate not to exceed 180 square feet per gallon of primer, and shall be brush or roller applied to prepared new concrete surfaces (previously uncoated, with no exposure to wastewater) at a rate not to exceed 200sq. ft. per gallon. The primer shall be allowed to cure to become tack-free before the mastic is applied. However, application of the primer shall precede the mastic application by no more than a 7 day period. Note: For extremely porous concrete more than one coat of primer may be required.

D. On new concrete surfaces, the polyurethane mastic shall be applied by troweling at an average minimum film thickness of 60 mils. The application of mastic shall not exceed that area which can be lined with the PVC sheets within 2 hours of mastic application or by the end of the work shift, whichever comes first.

E. The surface activator shall be roller applied to the PVC liner material and allowed to become tack-free prior to application to the substrate. Activated PVC sheets shall be protected from debris contamination prior to installation. The top surface of any sheet which will be lapped during installation shall be activated after the sheet is in place. The surface activator shall be applied using a roller.

F. The PVC sheet liner shall be applied within five minutes minimum and two hours maximum of mastic application. Mastic surface and the activated PVC sheet surface shall be kept clean and free of dust and debris until the lining is set in the mastic. The Contractor shall utilize the maximum size liner sheet possible at any application to minimize the number of seams. The edges of the lining shall be thoroughly sealed with the Hi Mod mastic where they join or terminate onto metal or concrete surfaces.

G. All surfaces of the PVC liner shall be thoroughly rolled to remove air inclusions and to ensure good adhesion to the polyurethane mastic. The rolling process
shall occur immediately after the PVC sheet application onto the polyurethane mastic.

H. The Contractor shall:

1. Roller apply the surface activator to activate the overlap zone 4 inches from the edge of any installed PVC sheet.

2. Activate the top face of a 4-inch wide band (on the opposite side) at the edge of each PVC sheet that will receive the seam material.

3. Trowel apply the seam material over this 4-inch wide activated area to a nominal thickness of 1/16 inch.

4. Apply the next sheet ensuring a 4-inch overlap.

5. Roll and press the overlap to remove all entrapped air and to force a bead of the Seam Material to be squeezed out at the seam.

6. Tool the excess Seam Material, adding additional Seam Material if required, to completely seal a 1-inch wide overlap of the PVC sheets with seam material having a minimum thickness of 1/8" or 125 mils, as described in the Linabond Application Guide (see section on Seams in the Linabond Application Guide). All seams must be taped with masking tape or otherwise clearly defined to provide a neat appearance.

I. All penetrations of the polyvinyl chloride liner shall be sealed with the seam material as indicated. The seam material shall be trowel applied.

J. For concrete previously exposed to wastewater, the total film thickness of the cured lining system shall not be less than 150 mils.

K. All lining system terminations at or around pipe supports/pipe or conduit penetrations, at hatch openings, and at all other terminations of or interruptions to the lining system shall be installed as indicated. All such terminations shall be sealed using the seam material.

L. When the surface temperatures of the concrete substrates to be lined are rising due to exposure to direct sunlight, outgassing of air from the concrete will result in excessive gas pockets in the lining system. Application of the lining system in such locations shall be postponed until the concrete is no longer exposed to direct sunlight, and its temperature is stable. The Contractor shall prevent such rising substrate temperatures by protecting concrete substrates from sunlight. (Note: This can be achieved by shifting work hours to evening or night time.) Should gas pockets or discontinuities form in the applied lining system, they shall be repaired as specified in paragraph 3.08.

M. Treatment of the lining system at expansion joints, cold joints, control joints, isolation joints' or cracks shall be installed as indicated.
N. The finished lining system shall be protected from damage during curing and shall be cured no less than three (3) days. The Contractor shall control ambient conditions during curing to ensure a temperature of 65°F or greater and a relative humidity of not more than 90%.

3.06 QUALITY CONTROL, INSPECTION, AND TESTING

Inspection by the Engineer, lining manufacturer representative, or others does not limit the Contractor's responsibility to install the lining system as specified herein.

The Contractor shall perform the quality control procedures listed below:

1. Inspect and record all lining system materials upon receipt to ensure that all are supplied by Linabond, Inc.

2. Provide specified storage conditions for the lining system, solvents and abrasives.

3. Verify and record that degree of substrate cleanliness using SSPC-VIS-1 for metallic substrates and visual inspection and pH testing for concrete substrates. Acceptable pH shall be between 7.0 and 12.0 as measured by a full range (7-12 min) color indicating pH paper with readable color calibrations and a scale of whole numbers (or smaller gradations). Use Hydrion Insta-Check Jumbo 0-13 or 1-12 or equal. The paper shall be touched to the surface once using moderate finger pressure unless the surface is very soft. If the surface is soft, it requires additional cleaning before pH testing. The surface shall not be wiped or moved laterally to disturb the surface during pH testing. Following the one touch, lift the paper vertically to not wipe the surface. Compare the color indicated with the scale provided and record the pH. When dry concrete substrate is encountered for a pH test, the surface where the pH test is to be performed shall be sprayed lightly with distilled, de-ionized water from a commercially available spray bottle that has been rinsed to preclude dissolved solids. The spray shall wet the surface and water shall not run down the wall. Wait 60 seconds to allow chemical equilibrium to be established and then test the pH of the water on the surface and record the value. If the concrete is dry, continue to spray lightly until a 60 second period will still provide a wet surface without water running down the wall for pH measurement. This visual inspection and pH testing shall be performed at least once for every 100 sq. ft. of surface area to be lined.

4. Verify and record substrate profile (anchor pattern) requirements using a K.T. Surface Profile Comparator for Metallic Substrates and visual inspection and comparison to a 60 to 80 grit sand paper sample for concrete substrates. Perform metal substrate profile measurements in accordance with ASTM D4417, once for every 25 sq. ft. of surface area to be lined. Perform profile comparison for concrete at this same frequency.

5. Measure and record ambient air temperature once every two hours during each shift (starting at the beginning of each shift) using a thermometer.
Measure and record substrate temperature once every two hours during each shift (starting at the beginning of each shift) using a surface thermometer.

6. Measure and record relative humidity every two hours of each shift using a sling psychrometer in accordance with ASTM E337.

7. Measure and record substrate moisture content using a Delmhoist Moisture Meter Model "DP." Press the two points into the prepared concrete substrate and press the test button. Read the substrate moisture content in percentage by viewing the percent level indicated by needle on the scale. Meter shall be calibrated to its most sensitive setting prior to each measurement. Perform this test once for every 50 sq. ft. of area to be lined and more frequently at darkened concrete areas. The acceptable moisture content for lining system application is no higher than 30 percent as measured using the Delmhoist meter.

8. Verify correct mixing of lining materials as specified herein.

9. Verify that the "pot life" of lining materials is not exceeded during installation.

10. Adhesion in Peel Testing: Test for inter-coat and overall lining system adhesion to the substrate in accordance with ASTM C794 modified for field conditions, as follows:

   a. Using a metal ruler and marker, mark a strip 1-inch wide and 6-inches long. Make marks at 1/2-inch increments along the strip using the ruler.
   
   b. Using a utility knife, cut through the PVC sheet making a loose end of the strip 3-inches long and 1-inch wide.
   
   c. Use a pair of vice grips or similar clamping tool to grip the loose end of the PVC strip.
   
   d. Attach the vice grips to a spring scale having a range of at least 50 lbs.
   
   e. Pull the scale away from the wall to pull the strip away from the mastic.
   
   f. Measure the force in pounds (lbs.) required to peel one linear inch of liner.
   
   g. The tester should wear a safety shield while performing this test.
   
   h. The minimum acceptable test value is 30 lbs/inch, except where the hot spray primer and Hi-mod mastic is used, where the minimum test value is 40 lbs/inch.
i. This test shall only be performed following a minimum of 7 days of lining system cure, and shall be performed once for every 250 sq. ft. of area to be lined. If acceptable test results are achieved in a structure or channel after four tests, this frequency of testing shall be modified to every 500 sq. ft. of area to be lined. The 250 sq. ft. frequency shall be reestablished whenever the protective lining work is moved to a new structure or area.

j. At any location where specified adhesion results are not obtained, additional adhesion testing as specified herein shall be performed at a different location within 1'-O" of the unacceptable test location on the same PVC sheet. If the specified result is obtained at this new location, the locations where testing was performed shall be repaired in accordance with paragraph 3.07(C). If specified adhesion results are not obtained after testing two locations on one PVC sheet, the Contractor shall remove the PVC sheet and install a completely new lining system where the sheet was removed at no additional cost to the Owner.

11. Verify continuity of lining system applied over metallic substrates in accordance with ASTM D5162. The lining must be 100% pinhole free. Pinhole testing (or continuity testing) shall be performed over 100% of the metal surface area lined. The voltage setting shall utilize the rule of 100 volts per mil of lining thickness.

12. Measure and record & thickness of the lining system using the following methods:

a. Polyurethane Mastic (over concrete) - use notched gauge in accordance with ASTM D4414 for Wet Film Thickness. Measure once every 10 sq. ft. area to be lined.

b. Polyurethane Mastic over ferrous metallic substrates - use magnetic or eddy current type gauges in accordance with ASTM E376 for Cured Dry Film Thickness. Measure once every penetration or once every 10 sq. ft. to be lined, whichever is more frequent.

13. Upon lining system installation completion while scaffolding is still in place, the surface of the lining system shall be cleaned and prepared to permit visual inspection, continuity testing, and adhesion testing:

a. All surfaces of the liner shall be visually inspected by the Contractor for areas showing poor adhesion, air inclusion, edges or seam defects or any other defects in the lining preventing a complete seal of the surfaces to be protected.

b. Continuity testing and adhesion testing shall be performed as specified herein.
c. Access to the liner surface shall be provided by the Contractor, by leaving the installation scaffolding in place for the duration of the curing and inspection period. The areas where the destructive testing (adhesion test) was performed shall be repaired per Paragraph 3.07 of this Section.

14. Holiday and Pinhole Spark Testing:

a. Location of holidays and pinholes in the lining system shall be performed in the field using spark testing. Upon completion of the lining system installation, the surface of the lining system shall be cleaned to permit visual inspection and holiday testing by the Contractor. All areas of the lining system failing to meet the field test shall be repaired and retested. The spark testing shall be done with a Tinker & Rasor Holiday Detector (Model AP-W). This testing shall be performed in accordance with ASTM D4787. Follow ASTM D-4787 Section 12, for adjusting the voltage setting for the lining system. Generally, the setting should total 100 volts per mil of lining system thickness.

b. Marking of Holidays: Holidays are to be marked on the lining system using felt tipped pens or other markers approved by Linabond. Holidays are to be repaired in accordance with the requirements of Paragraph 3.07. Holiday detection is to be repeated only over the lining repair locations.

3.07 FINAL INSPECTION

A final inspection shall be performed by the Contractor and the Engineer. Final inspection by the Contractor and Engineer shall include the following:

1. Average Dry Film Thickness (DFT) shall meet the requirements of paragraph 3.04.

2. Film thickness tolerance variations in lining system shall be as follows:

   Under specified Average Minimum DFT: 0.0 mils
   Over specified Average Maximum DFT: 10.0 mils

3. Lining system shall provide a sealed membrane to prevent penetration of H₂S gas, other gases, or liquids to the substrate, based on the following criteria:

   a. No materials applied following depletion of pot life or when exceeding maximum recoat times.
   b. No excessive runs, sags or sloughs.
   c. No pinholes or holidays.
   d. Specified film thicknesses within tolerances.
   e. No intercoat bond failures between system layers.
f. No entrapped air pockets behind PVC sheets greater than 4 inches in diameter.
g. Proper curing of lining as required herein.
h. Minimum PVC sheet lap lengths of 4” except on premolded corners where lap lengths of 3” are acceptable.
i. Sealing of all penetrations with HiMod mastic.
j. Proper application of pre-molded PVC Corners as specified herein.
k. Lining finish must be uniform and smooth with no rough edges, pinholes, or areas lower than specified lining thickness.

4. Rework required on any pinholes, holidays or any other rework required in the lining system shall be marked by the Contractor. Such areas shall be recleaned and repaired by the Contractor in accordance with Paragraph 3.07 at no additional cost to the Owner.

3.08 REPAIR OF PROTECTIVE LINING SYSTEM DEFECTS

A. The Contractor shall repair all defects, pinholes, and holidays in the protective lining system, as follows:

1. Clean an area 6" x 6" centered over the defect lining system area using a clean, white rag dampened with acetone to remove all dirt and dust. Allow to dry for five minutes.

2. Activate the 6" x 6" area over the defect using the Surface Activator.

3. Apply the Hi-mod polyurethane mastic (seam material) at 60 mils DFT over the activated area. Use a notched trowel.

4. Activate a 4" x 4" PVC sheet patch and press this into the Hi-mod polyurethane mastic and roll to remove entrapped air. This same repair procedure is to be used for punctures to the lining system.

B. Repairs to entrapped air pockets in the PVC sheets greater than 4-inches in any direction shall be performed by the Contractor as follows:

1. Cut open the PVC sheet comprising the air pocket. Trim to remove damaged PVC sheet to ensure that the PVC will lay flat when this repair is complete.

2. Clean an area extending at least 4 inches in all directions from the cut line in the PVC sheet using a clean white rag dampened with acetone to remove dirt and dust. Allow to dry for 5 minutes.

3. Apply the CLA-2 Surface Activator over the cleaned area.

4. Using a notched trowel, apply the Hi-mod mastic at 60 mils DFT over the activated area and force under the loose edges of the PVC sheet pressing them into the mastic.
5. Activate a PVC sheet patch large enough to cover the cut line in the air pocket with a 4-inch lap beyond the air pocket in all directions. Roll to remove entrapped air.

C. Damaged locations in the lining system caused by Adhesion in Peel Testing shall be repaired by the Contractor as follows:

1. Cut the peeled back lining material to remove it.

2. Clean a squared-up area a minimum of 6 inches in all directions from the removed PVC and mastic.

3. Activate a 6" x 6" peripheral area beyond the removed PVC and mastic using the CLA-2 Surface Activator.

4. Apply Hi-mod polyurethane mastic at 60 mils DFT over the activated area of the PVC sheet using a notched trowel. Completely fill the cut out area of mastic.

5. Activate a 5" x 5" piece of the PVC sheet and press this into the Hi-mod mastic and roll to remove entrapped air.

3.09 PROTECTIVE LININGS INSTALLATION SCHEDULE

Protective linings specified in this section shall be applied to the locations scheduled below:

<table>
<thead>
<tr>
<th>Structure</th>
<th>Location description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wet well</td>
<td>All interior concrete surfaces of the wet well structure above elevation ____</td>
</tr>
<tr>
<td>Wet well cover slab</td>
<td>Underside of all concrete surfaces of the wet well cover slab exposed to the interior of the wet well</td>
</tr>
</tbody>
</table>

**END OF SECTION**