

## SECTION 606 - PVC MANHOLE LINER

### 1. GENERAL

This specification covers the supply and installation of a flexible PVC sheet liner with locking extensions in reinforced concrete manhole sections to effectively protect the exposed concrete surfaces from corrosion. To accomplish this, the liner must be continuous and free of pinholes both across the joints and in the liner itself.

All work for and in connection with the installation of the lining in concrete manhole sections, and the field sealing and welding of joints, shall be done in strict conformity with all applicable specifications, instructions and recommendations of the lining manufacturer.

The manufacturer of the lining shall furnish an affidavit attesting to the successful use of its material as a lining for sewer pipes for a minimum period of 20 years in sewage conditions recognized as corrosive or otherwise detrimental to concrete.

### 2. MATERIAL

Liner shall be Amer-Plate T-Lock as manufactured by Ameron Protective Linings Division, Brea, California or approved equal.

A. Composition. The material used in the liner, welding strips and other accessory items, shall be a combination of polyvinyl chloride resin, pigments and plasticizers, specially compounded to remain flexible. Polyvinyl chloride resin shall constitute not less than 99 percent, by weight, of the resin used in the formulation. Copolymer resins will not be permitted.

#### B. Physical Properties.

1. All plastic liner plate sheets, welding strips and other accessory items, shall have the following physical properties when tested at 77° F  $\pm 5^\circ$ .

<u>Property</u>	<u>Initial</u>	<u>(Par.2.4)</u>
Tensile Strength	2200 psi min.	2100 psi min.
Elongation at break	200% min.	200% min.
Shore durometer, Type D (with respect to initial test result)	1-sec. 50-60 10-sec. 35-50	$\pm 5$ $\pm 5$
Weight change		$\pm 1.5\%$

2. Tensile specimens shall be prepared and tested in accordance with ASTM D412 using Die B. Weight change specimens shall be 1-inch by 3-inch samples. Specimens for testing of initial physical properties may be taken from liner plate

sheet and welding strip at any time prior to final acceptance of the work.

3. Liner plate locking extensions embedded in concrete shall withstand a test pull of at least 100 pounds per linear inch, applied perpendicularly to the concrete surface for a period of one minute, without rupture of the locking extensions or withdrawal from embedment. This test shall be made at a temperature of 70° - 80° F inclusive.
4. All plastic liner plate sheets, including locking extensions, all joint, corner and welding strips shall be free of cracks, cleavages or other defects adversely affecting the protective characteristics of the material. The engineer may authorize the repair of such defects by approved methods.
5. The lining shall have good impact resistance, shall be flexible and shall have an elongation sufficient to bridge up to ¼ -inch settling cracks, which may occur in the manhole wall or in the joint after installation, without damage to the lining.
6. The lining shall be repairable at any time during the life of the manhole.

C. Chemical Resistance. After conditioning to constant weight at 110° F, tensile specimens and weight change specimens shall be exposed to the following solutions for a period of 112 days at 77°F±5°.

At 28-day intervals, tensile specimens and weight change specimens shall be removed from each of the chemical solutions and tested in accordance with Paragraph 2.A.2. If any specimen fails to meet the 112-day exposure, the material will be subject to rejection.

<b>Chemical Solution</b>	<b>Concentration</b>
Sulfuric acid	20%
Sodium hydroxide	5%
Ammonium hydroxide	5%
Nitric acid	1%
Ferric chloride	1%
Bacteriological	BOD not less than 700 ppm.

D. DETAILS AND DIMENSIONS OF BASIC SIZE SHEETS

1. Liner sheets shall be a minimum of 0.065 inch in thickness. Locking extensions (T-shaped) of the same material as that of the liner shall be integrally extruded with the sheet. Locking extensions shall be approximately 2½ inches apart and shall be at least 0.375-inch high.
2. Sheets shall have a nominal width of 48 inches and a length of not more than 24 feet.
3. Sheets not used for shop fabrication into larger sheets shall be shop tested for pinholes using an electrical spark tester set between 18,000 and 22,000 volts. Any

holes shall be repaired and re-tested.

E. PIPE-SIZE SHEETS AND ACCESSORIES

1. Linings shall be supplied as pipe-size sheets, fabricated by shop-welding the basic-size sheets together. Shop welds shall be made by lapping sheets a minimum of ½ inch and applying heat and pressure to the lap to produce a continuous welded joint. Tensile strength measured across shop-welded joints in accordance with ASTM D412 shall be at least 2000 psi.
2. If required, strap channels shall be 1-inch wide maximum and formed by removing the locking extensions so that a maximum of 3/16 inch remains.
3. Sheets also can be supplied in prefabricated, pipe-size tubular-shaped sheets, ready to lower onto the inner manhole section forms. These normally do not require the use of strap channels.
4. Transverse flaps may be provided at the ends of sheets. Locking extensions shall be removed from flaps so that a maximum of 1/32 inch of the base of the locking extension is left on the sheet.
5. Welding strips shall be approximately 1-inch wide with a minimum width of 7/8 inch. The edges of weld strips shall be beveled in the manufacturing process. Thickness of weld strip shall be a nominal 1/8 inch.
6. Joint strips for pipe shall be 4-inches wide with a minimum width of 3 3/4 inches. Thickness of joint strips shall be a nominal of 3/32 inch.
7. Prior to preparing the sheets for shipment, the sheets shall be tested for pinholes using an electrical spark tester set between 18,000 and 22,000 volts. Any holes shall be repaired and re-tested.

3. INSTALLATION OF LINING

A. General

1. Installation of the lining, including preheating of sheets in cold weather and the welding of all joints, shall be done in accordance with the recommendations of the liner manufacturer.
2. All interior surfaces of the concrete manhole sections shall be lined.
3. The lining shall be installed with the locking extensions running parallel with the longitudinal axis of the manhole section.
4. The lining shall be held snugly in place against inner forms.
5. Locking extensions shall terminate not more than 1 ½ inches from the end of the inside surface of the pipe section. Joint flaps when used shall extend approximately 4 inches beyond the end of the inside surface.

6. Concrete placed against lining shall be vibrated, spaded or compacted in a careful manner so as to protect the lining and produce a dense, homogenous concrete, securely anchoring the locking extensions into the concrete.
7. In removing forms, care should be taken to protect the lining from damage. Sharp instruments shall not be used to pry forms from lined surfaces. When forms are removed, any nails that remain in the lining shall be pulled, without tearing the lining, and the resulting holes clearly marked.
8. All nail and tie holes and all cut, torn and seriously abraded areas in the lining shall be patched. Patches made entirely with welding strip shall be fused to the liner over the entire patch area. Larger patches may consist of smooth liner sheet applied over the damaged area with adhesive. All edges must be covered with welding strip fused to the patch and the sound lining adjoining the damaged area.
9. Hot joint compounds, such as coal tar, shall not be poured or applied to the lining.
10. The contractor shall take all necessary measures to prevent damage to installed lining from equipment and materials used in or taken through the work.

B. Application to Concrete Pipe Manhole Sections.

1. The lining shall be set flush with the inner edge of the bell or spigot end of a manhole section and shall extend to the opposite end or to approximately 4 inches beyond the opposite end depending upon the type of lining joint to be made with the adjoining concrete section.
2. Lined concrete manhole sections may be cured by standard curing methods.
3. Care shall be exercised in handling, transporting and placing lined sections to prevent damage to the lining. No interior hooks or slings shall be used in lifting the sections. All handling operations shall be done with an exterior sling or with a suitable fork lift.
4. On pipe having a 360° liner coverage, the longitudinal edges of the sheet shall be butt welded. When pipe tubes are furnished, these are shop-welded joints made in accordance with 2. E.1.
5. No manhole section with damaged lining will be accepted until the damage has been repaired to the satisfaction of the engineer.

C. Field Joints Lining.

1. The joint between sections of lined pipe shall be prepared in the following manner:

The inside joint shall be filled and carefully pointed with cement mortar in such a manner that the mortar shall not, at any point, extend into the pipe beyond the straight line connecting the surfaces of the adjacent pipe sections. Section joints must be dry before lining joints are made.

2. All mortar and other foreign material shall be removed from lining surfaces adjacent to the joint, leaving the surface clean and dry.

3. Field joints in the lining at section joints may be either of the following described types:

Type P-1: The joint shall be made with a separate 4-inch joint strip and two welding strips. The 4-inch joint strip shall be centered over the joint, heat-sealed to the lining, then welded along each edge to adjacent liner sheets with a 1-inch weld strip. The 4-inch joint strip shall lap over each sheet a minimum of ½ inch.

Type P-2: The joint shall be made with a joint flap with locking extensions removed per Paragraph 2.E.4 and extending approximately 4 inches beyond the pipe end. The joint flap shall overlap the lining in the adjacent pipe section a minimum of ½ inch and be heat-sealed in place prior to welding. The field joint shall be completed by welding the flap to the lining of the adjacent pipe section using 1-inch weld strip.

Care shall be taken to protect the flap from damage. Excessive tension and distortion in bending back the flap to expose the pipe joint during laying and joint mortaring shall be avoided. At temperatures below 50° F, heating of the liner may be required to avoid damage.

4. The joint flap or strip on beveled pipe shall be trimmed to a width (measured from the end of the spigot) of approximately 4 inches for the entire circumferential length of the lining.

5. All welding of joints is to be in strict conformance with the specifications and instructions of the lining manufacturer.

Welding shall fuse both sheets and weld strip together to provide continuous joint equal in corrosion resistance and impermeability to the liner plate.

Hot-air welding tools shall provide effluent air to the sheets to be joined at a temperature between 500° and 600° F. Welding tools shall be held approximately ½ inch from and moved back and forth over the junction of the two materials to be joined. The welding tool shall be moved slowly enough as the weld progresses to cause a small bead of molten material to be visible along both edges and in front of the weld strip.