SECTION 122

PLASTIC LINER PLATE

122.1 GENERAL

These specifications include material requirements and installation of the plastic liner plate.

122.2 REFERENCES

122.2.1 ASTM
D 1243

122.3 MATERIALS

122.3.1 PROPERTIES OF MATERIALS:

122.3.1.1 The materials used in all sheets of plastic liner plate and in all joint, corner, and welding strips shall be a polyvinyl chloride resin and other necessary ingredients compounded to make permanently flexible sheets and strips which are impermeable to sewage. Copolymer resins will not be permitted. Polyvinyl chloride shall constitute not less than 99 percent by weight, of the resin used in sheets and joint strips. The resin shall have a specific viscosity of 0.40 when measured in accordance with Standard Method of Test ASTM D 1243 and a 10 gram sample of the resin when heated in a 30 cu. cm. crucible at 100 degrees C for one hour shall have a loss not exceeding 0.7 percent. The resin used in welding and corner strips and other accessory pieces shall be of the highest molecular weight that is compatible with field welding.

122.3.1.2 The material used in joint strips and in plain sheets of plastic liner plate shall be identical to that used in sheets having locking extensions.

122.3.1.3 The CONTRACTOR shall submit to the ENGINEER manufacturer's certifications of compliance of each type of plastic liner sheet and strip proposed for use, together with a list of all ingredients from which the sheets and strips are to be compounded. The list shall show the percentage of use of each ingredient.

122.3.1.4 The samples will be subjected to the tests set forth hereinafter; and when the samples and their ingredients have been approved, no changes will be permitted without prior approval by the ENGINEER.

122.3.1.5 The samples shall show no significant changes when exposed to soaps; detergents; animal, vegetable, or mineral oils, fats, greases, or waxes; enzymes of sewer bacteria and fungi; or water solutions of any of the following chemicals at 85 degrees F:

Chemical	Concentration (Percent)
Sodium Hypochlorite	1
Ferric Chloride	1
Sulphuric Acid	20
Nitric Acid	1
Sodium Hydroxide	5
Ammonia	5

122.3.1.6 All plastic liner plate sheets; joint, corner, and welding strips; and accessories shall have the following physical properties when tested at 70 degrees F:

Tensile strength, minimum --- 2000 psi
Elongation at break, Minimum --- 200 percent

Shore Durometer (Type D) Readings
Instantaneous
50 minimum
60 maximum

10 Seconds
35 minimum
50 maximum

122.3.1.7 Liner plate locking extensions embedded in concrete shall withstand a test pull of at least 100 pounds per linear inch, applied perpendicular 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 between 70 degrees F to 80 degrees F inclusive.

122.3.1.8 All plastic liner plate sheets, including locking extensions, and joint, corner, and welding strips shall be free of

cracks, cleavages, or other defects adversely affecting corrosion resistance or required strength. The ENGINEER may authorize the repair of defects by approved methods.

122.3.1.9 Specimens taken at any time prior to final acceptance of the work from sheets and strips, when tested in accordance with tests specified herein-before, shall show no greater reduction in quality or change in dimensions than the reduction in quality and change in dimensions shown by the original approved samples when tested.

122.4 DETAILS AND DIMENSIONS

122.4.1 APPROVAL OF DETAILS: The CONTRACTOR shall submit for approval by the ENGINEER 30 days prior to any manufacturing of material, drawings showing details of liner plate, joint, corner, and other accessory plastic strips and devices. Such details shall conform to the requirements of these specifications and applicable provisions of the standard plans showing liner plate installation methods.

122.4.2 THICKNESS OF MATERIAL: Liner plate which is to be locked in concrete by means of integral extensions embedded in the concrete shall have a minimum thickness of 0.065 inch. Liner plate which is to be bonded to concrete or steel surfaces by means of adhesive shall have a minimum thickness of 0.075 inch. Welding strips shall have a minimum thickness of 0.125 inch plus or minus 0.031 inch.

122.4.3 SHEET AND STRIP SIZE: Sheets of liner plate used for pipe and cast-inplace sewers shall not exceed 16 feet 4 inches in length measured along the conduit. Sheets of liner plate for all other construction shall not exceed 16 feet by 16 feet. Said permitted maximum size shall be reduced where necessary to produce satisfactory results. Large sheets shall be formed by lapping basic size sheets a minimum of 1 inch in fusing the sheets together in such a manner as to produce a continuous welded joint. Specimens taken from welded joints shall show no cracks or separation and shall be tested in tension after flexing. Each specimen shall withstand a minimum load of 132 pounds per linear inch of weld or the product of 1800 and the minimum thickness in inches of the material adjoining the weld, whichever is greater. The thickness shall be taken within a 1 inch gauge length. The composition, corrosion resistance, and impermeability of specimens taken from the welded joints shall comply with the requirements of Subsection 122.3 above. Evidence of tears, cracks, or separation in the laps will be cause for rejection. Joint strips shall be four inches plus or minus 1/4 inch in width. Welding strips shall be one inch plus or minus 1/8 inch in width. Joint strips shall have each edge beveled prior to application. All welding and outside corner strips shall have edges beveled at time of manufacture. Sloping of the longitudinal terminal edges of liner plate at designated variations in circumferential coverage shall be as specified under Subsection 122.8 herein.

122.4.4 LOCKING EXTENSIONS: All liner plate applied to concrete shall have integral locking extensions embedded in the concrete, except that liner plate may be bonded to concrete surfaces with an adhesive if such is specifically shown on the plans, set forth in the Supplementary Specifications, or permitted by the ENGINEER. Locking extensions shall be of the same material as that of the liner plate, shall be integrally molded to or extruded with the sheets of liner plate, shall have an approved cross section with a minimum height of 3/8 inch and a minimum web thickness of 0.090 inch, shall be approximately 2 1/2 inches apart, and shall be such that when the extensions are embedded in concrete the liner plate will be held permanently in place. Locking extensions shall be parallel and shall be continuous except where omitted for joints and transverse weep channels. Weep channels which involve the omission of one inch of locking extensions as described in Subsection 122.8 herein may be made during the manufacture of liner plate. A locking extension shall be provided along all lower, terminal oblique, or longitudinal edges of liner plate.

122.4.5 PROVISIONS FOR STRAP CHANNELS: Unless alternate methods are approved by the ENGINEER, liner required to be secured to the inner form with straps shall have strap channels at not more than 20 inches on center perpendicular to the locking extensions. The channels, one-inch wide maximum, shall be formed by removing the locking extensions at strap locations so that a maximum of 3/16 inch of the base remains in the strap channel. Strap channels shall not be provided in the final two locking extensions adjacent to the terminal edge of the liner coverage.

122.5 TESTS

All liner plate shall be shop tested for holes, using an approved spark detector with a minimum of 20,000 volts. Sheets having holes shall be satisfactorily repaired in the shop and retested prior to shipping the sheets to the job site or the pipe manufacturing plant. Shop welds shall be subjected to testing for composition of the material after the weld has been made and for corrosion resistance, impermeability, and strength. Samples of liner plate shall be taken at the point of manufacture each week during production of sheet and strip material. These samples will be submitted to the ENGINEER for testing as provided in these specifications.

122.6 ADHESIVE

Adhesives used on liner plate shall be limited to those products made by the liner plate manufacturer specifically for use with the liner plate. Adhesives, solvents, and activators proposed for use shall be submitted to the ENGINEER for testing prior to use.

122.7 INSTALLATION OF PLASTIC LINER PLATE--GENERAL

112.7.1 INSPECTION: Wherever possible, liner plate shall be applied and secured to the forms and inspected and approved prior to the placement of reinforcing steel.

122.7.2 QUALIFICATIONS OF INSTALLERS:

122.7.2.1 APPLICATORS: The application of plastic liner plate to forms and other surfaces shall be considered as highly specialized work, and personnel performing this type of work shall be trained in methods of installation and demonstrate their ability to the ENGINEER.

122.7.2.2 WELDERS: Each welder shall successfully pass a welding test before making any field weld and may be retested at any time deemed necessary by the ENGINEER. All test welds shall be made in the presence of the ENGINEER and shall consist of the following: Two pieces of liner plate, at least 15 inches long and 9 inches wide, shall be lapped 1 1/2 inches and held in a vertical position. A welding strip shall be positioned over the edge of the lap and welded to both pieces of liner plate. Each end of the welding strip shall extend at least two inches beyond the liner plate to provide tabs. The weld specimen shall be submitted to the ENGINEER and tested as follows: Each welding strip tab, tested separately, shall be subjected to a 10 pound pull normal to the face of the liner plate with the liner plate being held firmly in place. There shall be no separation between the welding strip and the liner plate when the welding tabs are submitted to the test pulls. Three test specimens shall be cut from the welded sample tested in tension across the welds. If none of these specimens fail in the weld or within 1/2 inch adjacent to either edge of the weld when the specimens are individually subjected to a pull of 132 pounds per linear inch of weld or the product of 1800 and the minimum thickness in inches of the material adjoining the weld, whichever is greater, the weld will be considered as satisfactory in tension. The thickness used will be the minimum measured within a 1 inchgauge length. If one of the specimens fails to pass the tension test, a retest will be permitted. The retest shall consist of testing three additional specimens cut from the original welded sample. If all three of the retest specimens pass the test, the weld will be considered satisfactory. A disqualified welder may submit a new welding sample when, in the opinion of the inspector, he has had sufficient off-the-job training or experience to warrant re-examination.

122.8 PLACING LINER PLATE

122.8.1 COVERAGE: Liner plate shall cover, as a minimum, the areas shown on the plans to be lined. The variation in circumferential coverage at each longitudinal terminal edge of adjoining sheets of liner plate shall not exceed one inch or one percent of the inside diameter of pipe, whichever is greater. In the case of cast-in-place conduits, the inside height of the conduit shall be used in lieu of pipe diameter in determining allowable variation in circumferential coverage. At a station where there is a difference in coverage, as shown on the plans, and the longitudinal terminal edges of liner plate downstream from said station are lower than those upstream, the terminal edges of the liner plate installed in the section of pipe or structure immediately upstream from the station shall be sloped uniformly for the entire length of the section of pipe or structure from the limits of the smaller coverage to those of the greater coverage. Wherever the longitudinal terminal edges of liner plate downstream from the station are higher than those upstream, the slope shall be accomplished uniformly throughout the length of the section of pipe or structure immediately downstream from the station. An approved locking extension shall be provided along all tapered lower terminal edges of liner plate.

122.8.2 POSITIONING LINER PLATE: All liner plate installed in pipe shall be positioned so that the locking extensions are parallel with the axis of the pipe. Liner plate shall be centered with respect to the "T" of the pipe when the inner form is positioned. Liner plate shall be set flush with the inner edge of the bell end of the pipe section and shall extend to the spigot end or to approximately four inches beyond the spigot end, depending upon the type of liner plate joint to be made with adjoining pipe. All liner plate installed in a cast-in-place sewer shall be positioned so that the locking extensions are parallel to the axis of the sewer, and all liner plate installed in other sewer structures shall be positioned with locking extensions horizontal unless otherwise indicated on the plans or in the Supplementary Specifications. Liner plate sheets shall be closely fitted to inner forms. Sheets shall be cut to fit curbed and warped surfaces using a minimum number of separate pieces. The CONTRACTOR shall furnish field sketches to the ENGINEER showing the proposed layout of liner plate sheets for cast-in-place sewerage structures. The sketches shall show the location and type of all field welds. The ENGINEER may require the use of patterns or the markings of sheet layout directly on the forms where complicated or warped surfaces are involved. At transverse joints between regular size sheets of liner plate, the space between ends of locking extensions, measured longitudinally, shall not exceed four inches. Where sheets are cut and joined for the purpose of fitting irregular surfaces, this space shall not exceed two inches.

122.8.3 SECURING LINER PLATE IN PLACE: Liner plate shall be held snugly in place against inner forms by means of light gauge steel wire, light steel banding straps, or other approved means. Banding straps or wire shall be located in strap channels to prevent crushing or tilting the extensions. Means approved by the ENGINEER shall be provided, if necessary, to prevent crushing or tilting locking extensions on extruded sheets. Where the form ties or form stabilizing rods pass through liner plate, provisions shall be made to maintain the liner plate in close contact with the forms during concrete placement.

122.8.4 WEEP CHANNELS: At 8-foot intervals longitudinally along liner plate installed in sewers, a gap not less than one inch nor more than four inches wide shall be left in all locking extensions to provide an unobstructed transverse weep channel. Any area behind liner plate which is not properly served by regular weep channels shall have additional weep channels one inch wide provided by cutting away locking extensions. Provisions shall be made to permit water behind the liner of concrete manhole shafts to drain into the weep channels of the lined sewer. A transverse weep channel shall be provided approximately twelve inches away from each liner plate return where surfaces lined with plastic liner plate join surfaces which are not so lined. As a part of the work of installing liner plate, all outlets of transverse weep channels shall be cleared of obstructions which would interfere with their proper function.

122.8.5 LINER PLATE RETURNS: A liner plate return shall be installed wherever required as shown on the plans and wherever surfaces lined with plastic liner plate join surfaces which are not so lined, such as brick, clay pipe, cast-iron pipe, manhole frames, and metal, or clay tile gate guides. Unless otherwise indicated by the plans, the Supplementary Specifications, or the plans showing liner plate installation methods, returns shall be made as follows: Each liner plate return shall be a separate strip of liner plate at least four inches wide joined to the main liner plate by means of approved corner strips. Corner strips shall be continuously welded to the return and to the main liner plate and applied wherever possible from the back of the lining. Locking extensions shall be provided on returns to lock the returns to the concrete or plastic lined, cast-in-place structures. Locking extensions will not be required on liner plate returns installed on lined precast concrete pipe. Each liner plate return shall be sealed to adjacent construction with which it is in contact by means of a chemically resistant elastomeric material recommended by the manufacturer of the liner plate. If the joint space is too wide or the joint surfaces too rough to allow satisfactory sealing with this material, the joint space shall be filled with two inches of densely caulked cement mortar, lead wool, or other caulking material approved by the ENGINEER and finished with a minimum of one inch of an approved corrosion resistant material.

122.8.6 CORNERS: Liner plate corners shall be installed as detailed on the plans. If not so detailed and if the corner is a straight line, liner plate may be bent around the corner provided that the liner plate can be bent and secured in the forms in such a manner as to produce a satisfactory corner in the opinion of the ENGINEER. The radius of such a bend in liner plate shall not exceed one inch. Bending of liner plate to form a liner plate return will not be permitted. A separate liner plate return shall be installed at said locations in accordance with requirements specified in Subsection 122.8.5.

122.9 CONCRETE OPERATIONS

122.9.1 CONCRETE PLACEMENT: Concrete placed against liner plate shall be carefully vibrated so as to avoid damage to the liner plate and to produce a dense, homogeneous concrete securely anchoring the locking extensions into the concrete. External vibrators shall be used if deemed necessary by the ENGINEER. If steel stiffener rods are used along locking extensions of liner plate installed in forms for pipe, they shall be completely withdrawn during the placement of concrete in the forms. The concrete shall be revibrated to consolidate the concrete in the void spaces caused by the withdrawal of the stiffener rods.

122.9.2 REMOVING FORMS: In removing forms, care shall be taken to protect liner plate from damage. Sharp instruments shall not be used to pry forms from lined surfaces. When forms are removed, any nails that remain in the liner plate shall be pulled without tearing the liner plate and the resulting holes clearly marked. Form tie holes shall be marked before ties are broken off and all areas of serious abrasion of the liner plate shall be marked.

122.10 JOINING LINER PLATE

122.10.1 GENERAL: No field joint shall be made in liner plate until the lined sewer or structure has been backfilled and flooding required therefor has been completed. Liner plate at joints shall be free of all mortar and other foreign material and shall be clean and dry before joints are made. Hot joint compounds shall not be brought in contact with liner plate. No coating of any kind shall be applied over any joint, corner, or welding strip, except where nonskid coating is applied to liner plate surfaces.

122.10.2 FIELD JOINT IN PIPE INSTALLATION: Field joints in liner plate at pipe joints shall be one of the following types: Type P-1--A Type P-1 joint shall consist of a four-inch joint strip, centered over the mortared pipe joint and secured along each edge to adjacent liner by means of a welding strip. Type P-2--A Type P-2 joint shall be made with an integral part of the liner plate extending four inches beyond the spigot end of the pipe, overlapping the liner plate downstream from the pipe joint and secured to the downstream liner by means of a welding strip. The four-inch strip of liner plate

extending beyond the spigot end of the pipe shall be devoid of locking extensions and shall be protected from damage during pipe handling and jointing operations. Excessive tension and distortion in the strip caused bybending it back sharply at the end of the pipe will not be permitted. Any four-inch integral joint strip which has been bent and held back during pipe laying and jointing operations shall be released well in advance of making the liner plate joint to allow the strip to return to its original shape and flatness. On beveled pipe, the liner plate extension at the spigot end of the pipe shall be trimmed to extend four inches beyond and parallel to the beveled end. Joints between lined pipe and lined cast-in-place structures shall be either Type C-1 or Type C-2 specified hereinafter.

122.10.3 FIELD JOINTS IN CAST-IN-PLACE STRUCTURES: Field joints in liner plate on cast-in-place structures shall be one of the following types: Type C-1--A Type C-1 joint shall be made in the same manner as a Type P-1 joint. The width of the space between adjacent sheets of liner plate in a Type C-1 joint shall not exceed 1/2 inch. This type of joint is the only type permitted as transverse contraction joints in concrete. Its only other use is for joints between pipe and cast-in-place structures. Type C-2--A Type C-2 joint shall be made by over- lapping sheets not less than 1 1/2 inches and securing the overlap to the adjacent liner plate by means of a welding strip. The upstream sheet shall overlap the downstream sheet. The length of that part of the overlapping sheet not having locking extensions shall not exceed four inches. A welding strip shall be applied to the back of the joint if necessary to prevent leakage of concrete. This type of joint may be used at any transverse liner plate joint other than those at transverse contraction joints in concrete and shall be used for liner plate joints made at longitudinal joints in concrete. Type C-3--A Type C-3 joint shall be made by butting sheets of liner plate together and applying a welding strip over the back of the joint before concrete is poured and applying a welding strip over the front of the joint after concrete is poured. A Type C-3 joint will not be permitted at a transverse joint which extends to a lower terminal edge of liner plate or any joint where the gap between adjoining sheets of liner plate exceeds 1/8 inch.

122.10.4 INSTALLATION OF WELDING STRIPS: Welding strips shall be fusion welded to joint strips and liner plate by qualified welders using only approved methods and techniques. The welding operation of any joint shall be continuous until that joint has been completed.

122.11 APPLICATION OF LINER PLATE TO CONCRETE SURFACES BY MEANS OF ADHESIVE

122.11.1 Application and bonding of liner plate to concrete surfaces by means of adhesive shall be accomplished by the following steps: The concrete surface shall be etched in lieu of being sandblasted. After the sand blasting, the concrete surface shall be thoroughly cleaned of dust. Surfaces etched with acid shall be thoroughly washed with clear water after the etching and thoroughly dried before applying primer.

Grouting Procedure - All concrete im- perfections such as water and air pockets in poured concrete surfaces must be filled with cement grout. The concrete surface shall then receive two brush coats of an approved primer. Coverage shall not exceed 250 square feet per gallon for each coat. The first coat of primer shall be thinned with an equal amount of approved thinner. The first primer coat shall be permitted to dry for at least two hours before the application of the second primer coat. The second coat of primer shall be applied unthinned and permitted to dry for at least four hours. Brush apply one coat of manufacturer's recommended 19Y primer (at approximately 250 square feet/ gallon). The concrete surface and the back surface of the liner plate shall each be given one coat of an approved adhesive. Coverage shall not exceed 250 square feet per gallon for each coat.

122.11.2 One coat of an approved activator shall be applied to both the underside of liner plate and the adhesive coated concrete. Application of activator shall be limited to the extent that the application of coated liner plate can be completed within a 20-minute period. The activator shall be applied evenly by brushing. Coverage of activator shall not exceed 500 square feet per gallon. When the surface of the adhesive is barely tacky to the

touch, the liner plate shall be positioned with one edge firmly pressed down. The liner plate shall then be rolled into place, care being taken to avoid the formation of air pockets. All joints shall be tight-fitting butt joints. The surface of the liner plate shall be rubbed vigorously to secure the liner plate firmly in place. Corner and welding strips shall be positioned over all joints and welded in place. No adhesive shall be applied to liner plate or to any of the liner plate strips which willdeleteriously affect the plate or strips in any way. Adhesive shall not be applied to the surfaces of concrete at liner plate joints or to the surfaces of liner plate or joint strips opposite said mortar and concrete surfaces.

122.12 NONSKID SURFACES

All surfaces of liner plate shown on the plans to be nonskid shall be treated as follows: After all corner and welding strips have been installed, the surface of the liner plate shall be cleaned, dried, and sprayed with an adhesive coating recommended by the manufacturer of the liner plate. The surface shall then be liberally sprinkled with clean, dry, well-graded sand, all of which will pass a No. 40 sieve but be retained on a No. 70 sieve. After the sanded surface has thoroughly dried, all excess sand shall be brushed away and a seal coat of the coating shall be sprayed over the sand in sufficient quantity to coat and bond the sand to the liner plate. The coat sand surface shall be allowed to dry thoroughly before any walking is permitted thereon.

122.13 APPLICATION OF LINER PLATE TO STEEL

Fabrication and welding of steel to be lined with plastic liner plate shall be completed before the liner is installed. Steel surfaces to which plastic liner is to be applied shall be sandblasted, leaving surfaces free of all mill scale, rust, grease, moisture, and other deleterious substances. All interior welds shall be ground smooth and all weld spatter removed. The application of primer unthinned, adhesive, and liner plate to steel surfaces shall conform to the requirements set forth herein for bonding of liner plate to concrete surfaces with adhesive. Field joints shall be tight-fitting butt joints. After the liner plate has been applied to steel surfaces, corner strips, or welding strips shall be applied over all joints and welded in place.

122.14 PROTECTION AND REPAIR OF LINER PLATE

All necessary measures and precautions shall be taken to prevent damage to liner plate from equipment and materials used in or taken through the work. Any damage to installed liner plate shall be repaired by the CONTRACTOR in accordance with the requirements set forth herein for the repair of liner plate. All nail and tie holes and all cut, torn, and seriously abraded areas in the linerplate shall be patched. Patches made entirely with welding strip shall be fused to the liner plate over the entire patch. The use of this method is limited to patches which can be made with a single welding strip. The use of parallel, overlapping, or adjoining welding strips will not be permitted. Larger patches may consist of smooth liner plate over the damaged area with edges covered with welding strips fused to the patch and to the liner plate adjoining the damaged area. The size of a single patch of the latter type shall be limited only as to its width, which shall not exceed four inches. Wherever liner plate is not properly anchored to concrete or wherever patches larger than those permitted above are necessary, the repair of liner plate and the restoration of anchorage shall be as directed by the ENGINEER.

122.15 FIELD TEST

All liner plate, when installed, will be tested by the CONTRACTOR in the presence of the ENGINEER, using a spark type detector set at a minimum of 20,000 volts. All areas of liner plate failing to meet the field test shall be properly repaired and retested.

122.16 MEASUREMENT AND PAYMENT

Measurement for furnishing and installing plastic liner plate shall be included in the payment for the pipe or structure required to be lined, unless a different measurement is stipulated in the Bid Proposal.