

AM-LINER^{II}®

PATENTED

**GENERAL SPECIFICATION FOR THE
REHABILITATION OF SEWERS**

**USING THE AM-LINER^{II}®
PATENTED
(PVC) PIPELINING SYSTEM**

"TRENCHLESS TECHNOLOGY"

August 16, 2005

AMERICAN PIPE & PLASTICS, INC.

PIPE REHABILITATION BY THERMOFORMED (FOLD AND FORM) PIPE METHOD

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

The work specified under this section provides for the rehabilitation of an existing sewer pipeline or conduit using PVC Fold and Form trenchless technology. The process consists of installing a thermoformed PVC pipe liner inside an existing sewer (Host Pipe) from manhole to manhole as described in the following sections. When installed the liner will be a seamless, joint-less, solid wall PVC pipe liner that tightly conformed to the interior contours of the original host pipe. The liner shall be continuous from manhole to manhole with no seams or joints. In most cases required service connections will be reconnected using closed circuit television and remotely controlled cutters.

1.1.1 The PVC liner shall be the AM-LINER^{II} sewer rehabilitation system as supplied by American Pipe & Plastics, Inc.

1.1.2 "Approved equal". Alternative materials must be approved not less than 30 days prior to bid date.

1.2 REFERENCED DOCUMENTS

This specification references ASTM standards and other related standards, which are made a part hereof by reference and shall be the latest edition thereof.

ASTM D 638 () Standard Test Method for Tensile Properties of Plastics

ASTM D 790 () Standard Test Method for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

ASTM D 1784 () Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds

ASTM F 1867 () Standard Practice for Installation of Folded/Formatted Poly (Vinyl Chloride) (PVC) Pipe Type A for Existing Sewer and Conduit Rehabilitation

ASTM F 1871 () Standard Specification for Folded/Formatted Poly (Vinyl Chloride) Pipe Type A for Existing Sewer and Conduit Rehabilitation

ASTM F 2122 () Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings

NASSCO SG-11.010/03 Specification For Sewer Line Cleaning

1.3 PAYMENT

Payment for the work included in this section will be in accordance with the unit prices set forth in the Bid for the quantity of work performed. Work incidental to the lining process such as, bypass pumping, traffic control and other activities not listed on the Bid Form shall not be paid for directly but shall be considered subsidiary to the items on the Bid.

1.4 SUBMITTALS

1.4.1 The contractor shall submit for approval:

1.4.1.1 Shop Drawings, Product Data, Samples and Miscellaneous Submittals

1.4.1.2 Product technical data including physical properties data sheet and manufacturers installation instructions.

1.4.2 Certifications:

1.4.2.1 The Contractor shall be licensed directly by the manufacturer of the product and provide written certification that he is an experienced and qualified installer of the product.

1.4.2.2 Manufacturers certification that the product meets the requirements of the standards referenced

1.4.2.3 Submit documentation from the manufacturer that there is an established and ongoing quality control and quality assurance program for the product at the manufacturers production facility. This should include proof that the manufacturer has the necessary equipment and trained personnel to properly implement the program.

1.4.2.4 The holder of the lining system patent shall be the manufacturer of the PVC lining system and shall directly supply the licensed installer.

1.4.3 Phasing Plan including:

1.4.3.1 Bypass pumping procedure

1.4.3.2 Order of construction

1.4.3.3 Traffic control plan

1.5 SAFETY

The Contractor shall conform to all work safety requirements of pertinent regulatory agencies, and shall secure the site for the working conditions in compliance with the same. The Contractor shall erect such signs and other devices as are necessary for the safety of the work site.

The Contractor shall also perform all of the work in accordance with applicable OSHA standards. Emphasis shall be placed upon the requirements for entering confined spaces and working with steam.

1.6 AS-BUILT DRAWINGS

As Built drawings shall be provided by the Contractor within 2 weeks of final acceptance of the work. As-Built drawings will consist of marking the existing Contract Drawing with red pencil the changes between the existing Contract Drawings and Actual conditions measured or found in the field and the identification of work completed by the Contractor. The existing Contract Drawings will be provided to the Contractor at the onset of the project. As-Built drawings shall be kept on the project site at all times and shall be updated as the work is being completed. All updates to the contract documents shall be clearly legible.

PART 2 PRODUCTS

2.1 PIPELINER

2.1.1 General

The PVC pipe liner shall meet the requirements of ASTM F-1871

2.1.2 PVC Compound

The PVC compound used for the thermoformed PVC pipe shall conform to ASTM D 1784 CELL CLASSIFICATION 12111.

2.1.3 Pipe liner Physical Characteristics

The installed pipe liner shall provide the following minimum physical properties as listed below:

Table 2.1.3

<u>Physical Characteristics</u>	<u>Test Procedures</u>	<u>Pipe Material PVC</u>
Tensile Strength	ASTM D-638	3,600 psi
Tensile Modulus	ASTM D-638	155,000 psi
Flexural Strength	ASTM D-790	4,100 psi
Flexural Modulus	ASTM D-790	145,000 psi

2.1.4 Pipe liner Sizing

2.2.4.1 The liner shall be fabricated to a size which, when installed, will neatly fit the internal circumference of the conduit specified by the Engineer. Allowance for circumferential expansion during installation shall be made. The liner material shall be made only from a PVC compound especially designed for sewer rehabilitation.

- 2.2.4.2 The minimum length shall span the distance from the inlet to the outlet of the respective pipe to be lined. The Contractor shall verify the lengths in the field before insertion of the liner.
- 2.2.4.3 The minimum thickness shall be either SDR 32.5 OR SDR 26, depending upon the specific requirements of the pipeline as determined by the design calculations of a professional engineer. The minimum design thickness shall be calculated in accordance with the criteria set forth in appendix X1 of ASTM F 1867 and using a maximum reduction for long term modulus of 25%. When expanded to its full nominal diameter the minimum average wall thickness of the liner must be equal to or greater than the minimum requirement of the specified SDR as shown in the Table 2.2.4.3, when measured according to ASTM D 2122.

Table 2.2.4.3

Minimum Average Wall Thickness for Formed Liners		
Nominal O.D. in.	Minimum Average Wall Thickness, in.	
	SDR 32.5	SDR 26
6	0.185	0.231
8	0.246	0.308
10	0.308	0.385
12	0.369	0.462

2.2 MANUFACTURE

2.2.1 Pipe liner Marking

The pipe shall be marked at 5-foot intervals or less with the manufacturer's name or trade mark, product name, nominal outside diameter, dimensional ratio, PVC cell classification, date of manufacture, shift, state where production facility is located, and production line number.

2.2.2 Materials

The pipe liner shall be extruded from a specially formulated polyvinyl chloride (PVC) compound that meets the physical properties indicated in section 2.1.2 and the requirements of section 6 of ASTM F 1871.

2.2.3 Testing

Before shipment from the factory the product shall be tested in accordance with the manufacturers established quality control/quality assurance procedures. The testing requirements of the manufactures QC/QA program must equal or exceed those specified in ASTM F 1871.

PART 3 EXECUTION

3.1 PRE-INSTALLATION

3.1.3 Host Pipe Preparation

- 3.1.3.1 The host pipe shall be cleaned in accordance with SPECIFICATION FOR SEWER LINE CLEANING as provided by the National Association of Sewer Service Companies (NASSCO). For bidding purposes the Contractor shall assume that the pipes require normal cleaning which is defined as two to three passes with a jet cleaner unless unique conditions are noted as special provisions, on the TV log sheets or videos made available to the Contractor before the bid opening. Special additional cleaning not identified will be paid for on a time and material basis.
 - 3.1.3.2 Debris that would interfere with the installation of the pipe liner shall be removed. The Contractor shall dispose of debris in a location provided by the Owner and in accordance with all Federal, State and Local regulations
 - 3.1.3.3 The pipeline shall be cleared of obstructions such as solids, dropped joints, protruding service connections or collapsed pipe that may prevent pipe liner installation. If inspection reveals an obstruction that cannot be removed by conventional sewer cleaning equipment then a point repair excavation shall be made to uncover and remove or repair the obstruction. Such point repair shall be approved in writing by the Owner's representative prior to commencement of the work and shall be considered as a separate pay item.
 - 3.1.3.4 High levels of groundwater infiltration into the host pipe, that will affect the successful installation of the liner shall be remediated by either chemical grouting or point repair prior to lining as approved by the Engineer. Such repairs shall be approved in writing by the Owner's representative prior to commencement of the work and shall be considered as a separate pay item.
 - 3.1.3.5 Pre-Lining television Inspection: Prior to lining the Contractor shall inspect the pipeline by means of closed circuit television to identify any unknown defects or obstructions and to accurately locate active services. Color video recordings in VHS, MPEG, or .avi format shall be made of the television inspections and two copies each shall be supplied to the Owner along with a computer generated or hand written inspection report. The Contractor shall make accurate television inspection logs that clearly show the location, in relation to adjacent manholes, of each source of infiltration discovered. Other data of significance including the locations of service connections, joints, defective materials, unusual conditions, roots, storm sewer connections, collapsed sections, presence of scale and corrosion and other discernible features shall be recorded and two copies of such records shall be supplied to the Owner in printed format along with the video recordings. The contractor shall submit a report to the Owner detailing any defects in the pipeline that will prevent the successful installation of the liner. This report shall also contain a plan for proposed corrective action for repairs to the pipeline. Such repairs shall be approved in writing by the Owner's representative prior to commencement of the work and shall be considered as a separate pay item.
- 3.1.2 Flow Control

When required for acceptable completion of the pipe liner installation, the Contractor shall implement the pre-approved by-pass pumping plan in section 1.4.3.1.

3.1.3 Public Notification:

A public notification program shall be implemented, and shall as a minimum, require the Contractor to be responsible for:

- 3.1.3.1 Written notice to be delivered to each home or business describing the work, how it affects them and a local telephone number of the Contractor they can call to discuss the project or any problems, which could arise.
- 3.1.3.2 The written notice shall be delivered the day, or week prior to the beginning of work being conducted on the section relative to the residents affected.
- 3.1.3.3 Personal contact with any home or business, which cannot be reconnected within the time stated in the written notice.

3.2 LINER INSTALLATION

3.2.1 Pre Heating

Prior to insertion of the liner into the host pipe the Contractor shall pre-heat the liner in the manner proscribed by the manufacturers installation instructions. The heated liner must be pliable enough to be pulled into the host pipe with as little resistance as possible.

3.2.2 Pipe Liner Insertion

The liner pipe shall be inserted into the sewer through existing manholes, without modification of the manholes. Insertion of the liner into the host pipe will be accomplished by pulling the liner into the host pipe by means of a steel cable strung through the host pipe from a winch located at the downstream manhole. The end of the liner shall be prepared for attachment to the cable in accordance with the manufacturers instructions. The connection between the pulling cable and the prepared end of the liner shall be a swivel device to prevent twisting of the liner as it is pulled through the host pipe. The heated liner coil shall be placed in such a manner as to prevent damage to the liner as it is pulled through the manhole and into the host pipe.

A member of the installation crew at the upstream end shall monitor the speed of the pull; he must coordinate the speed of the pull with the winch operator at the downstream manhole via two-way radio. The crewmember coordinating the insertion of the liner shall ensure that the liner has the proper amount of slack, to prevent it from being either stretched or kinked.

3.2.3 Stress Relief

After the liner has been inserted into the host pipe, the Contractor shall relieve any stress imparted to the liner during the insertion in a manner proscribed in the manufacturer's installation instructions.

3.2.4 Processing

The Contractor shall supply suitable heat source equipment. The equipment shall be capable of delivering steam through the lining section to uniformly raise the temperature of the PVC material to effect forming of the liner pipe.

Suitable monitors shall be installed to gauge steam temperatures and temperatures at the input and exhaust ends of the liner. Steam monitoring methods and forming period shall be recommended by the liner manufacturer.

After forming the liner shall be cooled using compressed air or a mixture of compressed air and water. Cooling shall be deemed complete when the temperature of the exhaust air or air water mixture has remained constantly below 110°F for a minimum of 20 minutes.

3.2.5 Pipe Liner Trimming

After installation the ends of the PVC liner shall be cut off in the maintenance hole. The cuts shall be smooth and parallel with the maintenance hole wall. The finished liner shall not protrude into the maintenance hole over 2 inches.

If the maintenance hole has been lined through, the top half of the liner pipe may be cut off even with the top of the shelf, leaving the channel lined.

3.2.6 Sealing Manhole Connections

If a watertight seal is required at the manhole it may be accomplished by troweling a high viscosity epoxy cement or resin around the exposed ends of the liner and the surface of the manhole. The surface of the epoxy cement shall be shaped to smoothly transition the exposed liner to the manhole wall. If specified by the Owner a hydrophilic gasket may be placed between the pipe liner and the host pipe prior to expansion of the liner. In either case the exposed liner in the manhole shall be smoothly transitioned into the wall of the manhole using the epoxy cement.

3.2.7 Service Connections

The exact number and location of service connections shall be determined from the CCTV inspection done in section 3.1.3.5 of this specification. It shall be the Contractor's responsibility to accurately locate all existing service connections whether in service or not. The Contractor shall reconnect all potentially active service connections to the pipe liner, including those from unoccupied, abandoned or vacant lots. Capped service connections shall not be reconnected unless otherwise directed by the Owner. The Contractor shall be responsible for restoring/correcting, without delay, all missed service lateral connections. All service connections that are reinstated after lining shall be shown on the "As Built Drawings" with the exact distance from the upstream manhole.

All existing service connections shall be reinstated either by remotely controlled robotic device or by excavation.

Only experienced operators shall make robotic service connection reinstatements. Should a dimple not form or cannot be clearly ascertained at a given service connection its position must be carefully re-verified using the inspection video from 3.1.3.5.

Service reconnections shall be smooth and circular in nature as observed by a pan and tilt TV camera. The hole shall be a maximum of 105% and a minimum of 90% of the service pipe diameter. The opening shall be smooth and conform to the inside shape and size of the original connection. Trial cuts should be repaired per the pipe liner manufacturer's recommendations not be at no cost to the Owner.

3.3 POST INSTALLATION INSPECTION

Upon completion, and before acceptance of the work, the Contractor will inspect the rehabilitated pipeline using a CCTV camera with a pan and tilt head. The inspection shall be recorded on either VHS or DVD. The Operator will stop the camera at each lateral reinstatement and using the pan and tilt feature record and catalog each of the service connection cuts. The Contractor shall submit the post-installation video in either VHS or DVD format to the Owner for acceptance of the work.

3.4 INSPECTION AND TESTING

3.3.1 Visual Inspection

The pipe liner shall be continuous and joint-less. The pipe liner shall be free of all visual and material defects except those resulting from pre-lined host pipe conditions identified in the pre-lining video.

3.3.2 Testing

If required, the Contractor shall provide liner field samples to the Owner prior to installation for testing. The Owner will pay all expenses for the testing of liner samples to verify that the field samples meet the minimum specified values listed in Table 2.1.3. The samples shall be tested per the recommendations of the pipe liner manufacturer. The Contractor shall pay for the cost of re-tests made necessary by the failure of a sample to meet the minimum specified values listed in table 2.1.3. Field samples shall be collected in accordance with Section 7.3 of ASTM F 1867.

Normally separate leakage testing of the liner is not required, since the liner is under constant pressure during the cool down period. However, if separate leakage testing of the liner is required by the Owner in the specifications it shall be conducted at the time of installation after cool down and before the laterals are cut, in accordance with Section 7 of F 1867.

3.4 DEFECT REPAIR OR REPLACEMENT

Any defects, which in the judgment of the Owner and the pipe liner manufacturer that will affect the integrity or strength of the liner, shall be repaired or the pipe liner replaced at the Contractor's expense per the pipe liner manufacturers recommendations.. All repairs or replacement of defective work shall be completed to the full satisfaction of the Owner.

3.5 WARRANTY

The Manufacturer shall warrant the product for a period of 10 years from the date of manufacture, against failure as a result of defects in materials or manufacturing, and that when properly installed the product will perform in accordance with the Manufacturer's specifications, literature and data sheets.