

# PIPE REHABILITATION BY THERMOFORMED PVC ALLOY PIPELINER METHOD

(As provided by Ultraliner for use of Ultraliner PVC Alloy Pipeliner)

## PART 1 GENERAL

### 1.1 DESCRIPTION OF WORK

The work specified under this section consists of installing a thermoformed PVC Alloy pipeliner inside an existing sewer (Host Pipe) from manhole to manhole as described in the following sections. The PVC Alloy pipeliner shall be as supplied by Ultraliner, or equal. The PVC Alloy pipeliner is heated and expanded to fit tightly against the inner wall of the host pipe. Required connections to the sewer are to be robotically reinstated and shall fit tightly against the wall of the host pipe. The ends of the PVC Alloy pipeliner at the manholes are also to be sealed. The object is to restore the structural condition of the sewer and to eliminate infiltration from entering the lined section of sewer.

### 1.2 DEFINITIONS

1.2.1 Thermoformed PVC Alloy pipeliner: A continuously extruded (joint-less), polyvinyl chloride pipeliner that is shaped into a reduced form to facilitate insertion into existing pipelines or conduits. The 4" to 12" PVC Alloy pipeliner shall be coiled in a flat shape and folded during insertion, whereas the 15" and larger PVC Alloy pipeliner shall be coiled in an "H" shape. The PVC Alloy pipeliner shall be designed to return to its extruded, round memory upon application of heat alone and to be formed tightly against the host pipe by thermoforming techniques.

1.2.2 Host Pipe: An existing gravity or low-pressure pipeline or conduit to be internally rehabilitated by installation of the PVC Alloy pipeliner.

### 1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

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

ASTM F 1504 ( ) Standard Specification for Folded Poly(Vinyl Chloride) (PVC) Pipe for Existing Sewer and Conduit Rehabilitation

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

ASTM D 790 ( ) Standard Test Methods 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 D 2412 ( ) Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading

ASTM D 2444 ( ) Standard Test Method for Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight)

### 1.4 MEASUREMENT AND PAYMENT

Measurement and payment for the work described in this section is to be paid on under the following unit prices.

Item # ( ) Installation of ( ")Diameter Liner

Payment to be made by number of lineal feet installed complete in place; measured from down-stream edge of up-stream manhole to up-stream edge to down-stream manhole.

Item # ( ) Reinstatement of service connections by excavation.

Payment to be made by number of service connections reinstated, complete in place.

Item # ( ) Reinstatement of service connections by robotic cutter.

Payment to be made by number of service connections reinstated.

Item # ( ) Sealing of robotically reinstated service connections.

Payment to be made by number of service connections reinstatement sealed, including sealing material.

## 1.5 SUBMITTALS

### 1.5.1 Materials

The contractor shall provide samples of the proposed PVC Alloy pipeliner for prior approval.

### 1.5.2 Drawings and Technical Information

The Contractor shall submit for approval drawings and/or technical information on all materials and equipment required to complete the project in accordance with the contract documents. Technical information shall include detailed Installation Guidelines and a Letter of Material Property Certification as provided by the Technology Supplier.

### 1.5.3 Schedules

The Contractor shall submit for approval a detailed plan outlining his proposed sequence of construction and his estimated schedule for accomplishing the various phases of the work. The Contractor shall indicate his best estimate of the time (in hours or days) required for the performance of each phase of the work.

## 1.6 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.

## 1.7 AS-BUILT DRAWINGS

The Contractor shall provide as-Built drawings 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 field conditions measured or found in the field and the identification of the 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, shall be updated as the work is being completed, and shall be clearly legible.

**PART 2 PRODUCTS**

**2.1 PVC ALLOY PIPELINER MATERIAL**

**2.1.1 General**

The thermoformed PVC Alloy pipeliner shall comply with the performance requirements of either ASTM F-1871 or ASTM F-1504, and meet or exceed the minimum physical characteristics described within this section. The Contractor shall be capable of installing PVC Alloy pipeliners that comply with each of the ASTM F-1871 and F-1504 standards, thereby permitting the \_\_\_\_\_ to make a choice, in advance, of which material to use on specific line segments.

**2.1.2 Experience Requirements**

**2.1.2.1 Product Supplier**

The product supplier shall have in excess of one million feet installed in North America under various climatic conditions, as evidence of a successful field performance history. Additionally, the product supplier shall have available for contractor and End-User support by phone, a field service support person with a minimum of 100,000 linear feet of experience with the product. Qualified technical support personnel shall also be available to the contractor and End-User for questions regarding applicability for use of the products. On-site support shall also be available on an as-needed basis.

**2.1.2.2 Contractor**

The contractor performing the installation shall be a Licensed Installer of the PVC Alloy Pipeliner and the Field Superintendent shall have received adequate training from the technology supplier.

**2.1.3 Acceptable Manufacturers**

Ultraliner PVC Alloy Pipeliner as supplied by Ultraliner, Oxford, Alabama or approved equal shall be used. Alternate materials must be approved not less than 30 days prior to bid date.

**2.1.4 PVC Alloy Compound**

The PVC Alloy compound used for the thermoformed PVC Alloy pipeliner shall conform to ASTM D-1784 cell classification 16111 or 16223.

**2.1.5 PVC Alloy Pipeliner Physical Characteristics**

The installed PVC Alloy pipeliner shall provide the following minimum physical characteristics as defined by the applicable product standard, either ASTM F-1871 or ASTM F-1504:

Design Parameter	Minimum Value		ASTM Test Method
	ASTM F-1871	ASTM F-1504	
Pipe Impact Resistance	15 ft-lb/in		D-256
Pipe Flattening	60% deflection		F-1871 & F-1504 Sect 11.3
Flexural Modulus of Elasticity	145,000 psi	280,000 psi	D-790
Tensile Strength	3500 psi	5,000 psi	D-638

## 2.1.6 PVC Alloy Pipeliner Dimensions

### 2.1.6.1 Length

The length of the PVC Alloy pipeliner shall be that which is deemed necessary by the Contractor to effectively carry out the insertion and to seal the PVC Alloy pipeliner at the inlet and outlet of the manhole. Individual insertions may be made over one or more manhole-to-manhole sections as determined. The product supplier shall be capable of supplying continuous lengths exceeding 500' in all applicable diameters to ensure the capability of spanning from each end of the host pipe without excavation.

### 2.1.6.2 Extruded Diameter & Wall Thickness

The PVC Alloy pipeliner shall be manufactured with a diameter substantially smaller than the inside diameter of the host pipe. The pipeliner shall be manufactured with sufficient excess wall thickness to allow the pipeliner to meet or exceed the DR requirements after being thermoformed.

### 2.1.6.3 Installed Dimension Ratio

The Dimension Ratio (DR) of the installed PVC Alloy pipeliner will be selected from Table I. The selection of appropriate DR shall be in compliance with the structural requirements as determined by the environmental loading conditions.

TABLE 1						
Pipeliner Nominal OD, Inches	Host ID Range, Inches		Resulting DR Range for Nominal DR			
	Minimum	Maximum	<b>32.5</b>	<b>35</b>	<b>41</b>	<b>50</b>
4	3.70	4.20	30-37	*	*	*
6	5.60	6.30	30-37	33-42	*	*
8	7.40	8.40	30-37	33-42	*	*
9	8.30	9.40	30-37	33-42	*	*
<b>10</b>	9.30	10.5	30-37	33-42	39-50	*
<b>12</b>	11.30	12.80	30-37	33-42	39-50	*
<b>15</b>	13.90	15.70	30-37	33-42	39-50	*
<b>18</b>	17.50	19.60		33-42	39-50	<b>48-61</b>

[Note: 21' and 24" PVC Alloy pipeliners are also available]

## 2.2 PVC ALLOY PIPELINER MANUFACTURE

### 2.2.1 Marking

The PVC Alloy pipeliner shall be marked at 5-foot intervals or less with the manufacturer's name or trademark and code, the nominal outside diameter, PVC cell classification, dimension ratio, and length in accordance with the applicable product standard, either ASTM F-1871 or ASTM F-1504.

### 2.2.2 Materials

The PVC Alloy pipeliner shall be manufactured from a specially formulated polyvinyl chloride (PVC) compound complying with Part 2.1. The ASTM F-1871 and the ASTM F-1504 materials shall be distinguished by disparate colors to simplify inspection of proper materials and for inventory management at the jobsite. The PVC Alloy pipeliner shall have high resistance to chemical degradation ensuring suitability for use under general sanitary sewer conditions. The material shall be NSF approved as an indication of its lack of impact on the environment and human health.

### 2.2.3 Testing

The materials shall be tested in accordance with the testing requirements of the applicable product standard, either ASTM F-1871 or ASTM F-1504.

### 2.2.4 Storage and Shipping

To permit longer lengths and to avoid damage, the pipeliner shall be stored and shipped on wooden reels.

## 2.3 PVC ALLOY PIPELINER FIELD PERFORMANCE CHARACTERISTICS

The PVC Alloy pipeliner will be designed to meet the following installation performance requirements:

2.3.1 The PVC Alloy pipeliner shall be capable of expanding a full pipe size larger than the nominal diameter (ex.: 8" to 10") without splitting, or rupturing.

2.3.2 After being thermoformed, the installed PVC Alloy pipeliner will precisely conform to the configuration of the host pipe, with a concave dimple typically appearing at each service connection.

2.3.3 The PVC Alloy pipeliner shall be capable of negotiating pipeline bends in the host pipe without splitting, rupturing or wrinkling of the pipeliner material.

2.3.4 The PVC Alloy pipeliner shall be dimensionally stable immediately after cool-down, so as to permit immediate service connection reinstatement.

2.3.5 The PVC Alloy pipeliner shall have an ASTM D-1784 impact resistance cell classification of no less than five (5), to resist splitting during remote controlled service connection reinstatement.

2.3.6 Processing of the PVC Alloy pipeliner shall cause no degradation of the pipeliner physical properties.

## PART 3 EXECUTION

### 3.1 INSTALLATION

#### 3.1.1 Host Pipe Preparation

The existing pipeline shall be cleaned of any obstructions, televised using closed circuit TV cameras in accordance with Section \_\_\_\_\_ and the condition of the pipeline approved by \_\_\_\_\_ prior to the insertion of the PVC Alloy pipeliner.

Prior to beginning the insertion of the PVC Alloy pipeliner, the Contractor shall confirm that he is satisfied that the lines are adequately cleaned. This confirmation shall serve as evidence of his acceptance of the condition of the pipeline and the suitability of PVC Alloy pipeliner insertion within the host pipe.

#### 3.1.2 Flow Control

When required for acceptable completion of installation, the Contractor shall provide adequate Flow Control including required pumping and bypassing of wastewater flows.

#### 3.1.3 PVC Alloy Pipeliner Insertion

The pre-heated PVC Alloy pipeliner shall be positioned to enable it to naturally curve into the manhole and directly into the host pipe. The PVC Alloy pipeliner shall be pulled into the pipeline by means of a winch cable extending the length of the host pipe. The PVC Alloy pipeliner shall be uncoiled at approximately the same speed that it is being pulled as evidenced by slack in the pipeliner as it uncoils. In order to limit insertion stresses, speed should be adjusted according to the pipeliner temperature, the required pulling force, and the risk of abrasion.

#### 3.1.4 PVC Alloy Pipeliner Plugging

After the folded PVC Alloy pipeliner is inserted into the host pipe, it shall be cut at each end with a sufficient length of pipeliner extending into at least one manhole and allowed to contract to permit relaxation of insertion stresses. The pipeliner ends shall be equipped with flow-through plugs or fittings to allow for the controlled introduction and release of steam and pressure.

### 3.1.5 Installation Monitoring Equipment

Properly calibrated temperature and pressure gauges shall be placed at both the upstream and downstream ends to monitor installation temperature and pressure.

### 3.1.6 PVC Alloy Pipeliner Heating and Relaxation

The PVC Alloy pipeliner shall be heated with steam according to the technology supplier's Installation Guidelines. The PVC Alloy pipeliner shall be allowed to relax any insertion stresses by means of an adequate heating period after pipeliner insertion and prior to pipeliner expansion. A pipeliner that continues to longitudinally shrink shall not be restrained or expanded until such longitudinal stresses are permitted to relax.

### 3.1.7 PVC Alloy Pipeliner Expansion

Once the PVC Alloy pipeliner has been thoroughly heated to permit proper expansion, the pipeliner shall be expanded with sufficient air and steam pressure to form tightly against the host pipe. Temperatures and pressures shall be monitored to ensure that the minimums and maximums recommended within the technology supplier's Installation Guidelines are not exceeded.

### 3.1.8 PVC Alloy Pipeliner Cool-down

After the PVC Alloy pipeliner is thermoformed tightly to conform to the host pipe, the Contractor shall cool the pipeliner to a temperature as directed by the technology supplier's Installation Guidelines before relieving the pressure required to hold the PVC Alloy pipeliner tightly against the host pipe. The cooling is accomplished by converting from pressurized steam to compressed air. In no case shall this temperature be in excess of 100°F. An ice bath or an after-cooler will generally be necessary to cool the PVC Alloy pipeliner to the required temperature.

### 3.1.9 PVC Alloy Pipeliner Trimming

The Contractor will neatly and smoothly trim the PVC Alloy pipeliner at the upstream manhole and the downstream manhole to preclude snagging and shoaling of debris. After trimming, the PVC Alloy pipeliner shall extend a minimum of 3 inches into the manhole in order to maintain the tight fit created by the flaring of the PVC Alloy pipeliner.

### 3.1.10 Sealing Manhole Connections

A hydrophilic gasket may be placed between the PVC Alloy pipeliner and the host pipe prior to expansion to ensure a water-tight seal. If the installed PVC Alloy pipeliner fails to make a tight seal at the manhole, the Contractor will apply a sealant at that point. The sealant shall be a mixture compatible with that used in the process. Properly applied chemical sealing material (grout) can also be used to achieve a seal at the manhole.

### 3.1.11 Service Reconnections

The exact location and number of service connections shall be determined from the initial CCTV inspection and/or in the field. It shall be the Contractor's responsibility to accurately field locate all existing service connections whether in service or not. The Contractor shall reconnect all service connections to the PVC Alloy pipeliner including those from unoccupied, abandoned or vacant lots, unless directed otherwise. The Contractor shall be responsible for restoring/correcting, without any delay, all missed or faulty reconnections, as well as for any damage caused to buildings for not reconnecting the services soon enough or for not giving notice to the building occupants. All service connections that are reinstated after lining shall be shown on the "As Built Drawings" with the exact distance from the nearest upstream/downstream manhole.

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

Only experienced operators shall make robotic service connection reinstatements. Location shall be re-verified carefully with earlier tapes for accuracy, especially where dimples are not defined or clearly ascertained. The \_\_\_\_\_ reserves the right to require service connection by excavation at certain or all locations if the quality, workmanship, and approval rating for remote service reconnects are unsatisfactory.

The remote service reconnects shall be smooth and circular in nature as seen by a 360 degree TV camera. The hole shall be a maximum of 100% and a minimum of 90% of the service pipe diameter. It shall be properly aligned and shall be concentric to the existing connection. Excess, wrong holes, or trial cuts shall not be made and must be repaired at no extra cost to the full satisfaction of the \_\_\_\_\_. The \_\_\_\_\_ may check the completed remote service reconnects for the minimum 90% requirement by excavating the site, in which case payment shall be made for the excavation at that location and for any special backfill, if necessary. Defective service reconnects shall be repaired to the \_\_\_\_\_'s satisfaction at no extra cost.

### 3.2 VHS TAPE SUBMITTALS

Upon completion, and before acceptance of the work, the Contractor will re-inspect the rehabilitated pipeline by the use of CCTV cameras and shall submit pre-installation and post-installation color VHS tapes of the rehabilitated pipeline to the \_\_\_\_\_ for approval/acceptance of the work.

### 3.3 INSPECTION AND TESTING

#### 3.3.1 Visual Inspection

The PVC Alloy pipeliner shall be continuous and joint-less. The PVC Alloy pipeliner shall be free of all visual and material defects except those resulting from pre-lined conditions. (Such conditions shall be brought to the attention of the \_\_\_\_\_ prior to lining.)

#### 3.3.2 Testing

The \_\_\_\_\_ may at any time direct the manufacturer to obtain any reasonable number of test pieces of raw material (compound and/or pipe) samples as may be required, stamped or marked with the date of manufacture and batch number if applicable and to prepare test specimens in accordance with the testing requirements of the applicable product standard, either ASTM F-1871 or ASTM F-1504. These specimens will be tested independently. Physical property testing shall be performed in conformance with the manufacturer's published testing guidelines. In all cases, the average testing results of the number of specimens shall be used to determine conformance with the detailed requirements.

Pressure testing of the PVC Alloy pipeliner can be accomplished by low-pressure air test prior to reinstatement of any service connections. Normally, separate testing is not required since the PVC Alloy pipeliner is under constant pressure during the cool down period.

### 3.4 DEFECT REPAIR OR REPLACEMENT

Any defects, which in the judgment of the \_\_\_\_\_ will affect the integrity or strength of the lining, shall be repaired or the PVC Alloy pipeliner replaced at the Contractor's expense. All repairs or replacement of defective work shall be completed to the full satisfaction of the \_\_\_\_\_

END OF SECTION