General Specification for the Rehabilitation of Sewers and Culverts using NOVAFORM™ PVC Liner 'Expand-in-Place' Method

NOVAFORM™
PVC LINER

IPEX
by aliaxis

NovaForm™ Expand-in-Place Styrene-Free PVC Liner

General Specification

Pipe Rehabilitation by Thermoformed 'Expand-In-Place' Pipe Method

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

The work specified under this document provides for the rehabilitation of existing sewer pipelines and culverts using PVC 'Expand-in-Place' trenchless technology. The process consists of installing a thermoformed PVC pipe liner inside an existing sewer or culvert (Host Pipe) from manhole to manhole or from one access point to the other.

When installed, the liner will be a seamless, joint-less, solid wall PVC pipe lining that tightly conforms to the interior contours of the original host pipe. The required service connections will be reconnected using closed circuit television and remotely controlled cutters.

1.1.1 The Pipe liner shall be the NovaForm PVC Liner sewer and culvert rehabilitation system as supplied by IPEX Inc.

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

1.1.3 Manufacturer – The manufacturer of NovaForm PVC liner i.e. IPEX Inc.

1.1.4 Contractor – The approved installer of NovaForm PVC liner.

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 D638	Standard Test Method for Tensile Properties of Plastics
ASTM D790	Standard Test Method for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
ASTM D1784	Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
ASTM F1947	Standard Practice for Installation of Folded/Formed Poly (Vinyl Chloride) (PVC) Pipe for Existing Sewer and Conduit Rehabilitation
ASTM F1504	Standard Specification for Folded/Formed Poly (Vinyl Chloride) Pipe for Existing Sewer and Conduit Rehabilitation
ASTM F2122	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, by-pass 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 trained and approved 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 manufacturer's production facility. This should include proof that the manufacturer has the necessary equipment and trained personnel to properly implement the program.

1.4.3 Phasing Plan:

The contractor shall submit the below documents for Engineering approval prior to the commencement of the job.

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 BASIC MATERIALS

The pipe shall be made from PVC compound meeting all the requirements for cell classification 12334 as defined in specification D1784 and with minimum physical properties:

Tensile Strength	ASTM D638	6,000 psi	(41.4 MPa)
Tensile Modulus	ASTM D638	320,000 psi	(2,206 MPa)
Flexural Strength	ASTM D790	6,000 psi	(41.4 MPa)
Flexural Modulus	ASTM D790	320,000 psi	(2,206 MPa)
Heat Deflection Temperature (tested @ 264psi)	ASTM D648	158°F	(70°C)

2.2 OTHER REQUIREMENTS

2.2.1 Flattening

There shall be no evidence of splitting, cracking or breaking when the rounded pipe is tested according to section 11.3 of ASTM F1504.

2.2.2 Impact Strength

The impact strength of rounded pipe shall not be less than the values in Table 1 when tested in accordance with ASTM D2444 as referenced in ASTM F1504.

Table 1: Minimum Impact Strength at 73°F (23°C)

Pipe size, in. (mm)	Impact strength, ft-lbf (J)
6 (150)	210 (284)
8 (200)	210 (284)
10 (250)	220 (299)
12 (300)	220 (299)
15 (375)	220 (299)
18 (450)	220 (299)
24 (600)	220 (299)
30 (750)	220 (299)

2.2.3 Stiffness

Values for pipe stiffness for the rounded pipe shall comply with Table 2 when tested in accordance with ASTM D2412 as referenced in ASTM F1504.

Table 2: Minimum Pipe Stiffness at 5% Deflection

Pipe Size, in. (mm)	Wall Thickness, in. (mm)	Pipe Stiffness, psi (kPa)
6 (150)	0.17 (4.3)	36 (250)
8 (200)	0.23 (5.8)	36 (250)
10 (250)	0.28 (7.3)	36 (250)
12 (300)	0.34 (8.7)	36 (250)
12 (300)	0.29 (7.4)	22 (153)
15 (375)	0.30 (7.6)	12 (83)
18 (450)	0.27 (6.9)	6 (41)
24 (600)	0.36 (9.2)	6 (41)
30 (750)	0.45 (11.5)	6 (41)

2.2.4 Extrusion Quality

The extrusion quality of the pipe shall be evaluated by both of the following test methods:

2.2.4.1 Acetone Immersion: The pipe shall not flake or disintegrate when tested in accordance with ASTM D2152 as referenced in ASTM F1504.

2.2.4.2 Heat Reversion: The extrusion quality of the pipe shall be estimated by heat reversion method in accordance with practice F1057 as referenced in ASTM F1504.

2.2.4.3 Flexural Properties: The flexural strength and modulus of the pipe shall be tested in accordance with ASTM D790 as referenced in ASTM F1504.

2.2.5 Dimensions

2.2.5.1 Formed Pipe Diameter: The average outside diameter of the formed pipe shall meet requirements in Table 3, +/- 1.0% when tested in accordance with ASTM D2122 as referenced in ASTM F1504.

2.2.5.2 Formed Pipe Wall Thickness: The wall thickness of the formed pipe shall not be less than the values specified in Table 3 when tested in accordance with ASTM D2122 as referenced in ASTM F1504.

Table 3 Rounded Pipe Dimensions

Nominal Outside Diameter In. (mm)	Minimum Wall Thickness In. (mm)	
6 (150)	0.17	(4.3)
8 (200)	0.23	(5.8)
10 (250)	0.28	(7.3)
12 (300)	0.34	(8.7)
12 (300)	0.29	(7.4)
15 (375)	0.30	(7.6)
18 (450)	0.27	(6.9)
24 (600)	0.36	(9.2)
30 (750)	0.45	(11.5)

Note: As per the ASTM F1504 standard, some sizes are available in multiple thicknesses, as shown in the table above.

2.2.6 Workmanship, Finish, and Appearance

The formed pipe shall be homogeneous throughout and free from visible cracks, holes, foreign inclusions, or other defects. The pipe shall be as uniform as commercially possible in colour, opacity, density and other physical properties.

2.2.7 Product Marking

Pipe shall be clearly marked as follows at intervals of 5ft. (1.5m) or less:

- Manufacturer's name or trademark and code
- Nominal outside diameter
- The PVC cell classification, for example "12334"
- The legend "DR XX FOLDED PVC PIPE"
- The designation "Specification ASTM F1504"
- Length marker and liner distance label, for example "100ft" ("30.5m")

2.2.8 Packaging

The full length of the PVC pipe is coiled onto a reel in a continuous length for storage and shipment. The minimum diameter of the reel drum or core shall be 48in (1,219mm).

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 manufacturer's 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 manufacturer's 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 pressures 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 90°F for a minimum of 10 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 4 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 placing a hydrophilic gasket between the expanded liner and the host pipe prior to expansion of the liner.

3.2. Service Connections

The exact number and location of service connections shall be determined from the CCTV inspection done in section 3.1.1.5 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 3.1.1.5.

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 and 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 Section 2.1. 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 Section 2.1. Field samples shall be collected in accordance with Section 7.3 of ASTM F1947.

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 F1947.

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 manufacturer's 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.

About IPEX by Aliaxis

As leading suppliers of thermoplastic piping systems, IPEX by Aliaxis provides our customers with some of the world's largest and most comprehensive product lines. All IPEX by Aliaxis products are backed by more than 50 years of experience. With state-of-the-art manufacturing facilities and distribution centers across North America, we have established a reputation for product innovation, quality, end-user focus and performance.

Markets served by IPEX by Aliaxis products are:

- Electrical systems
- Telecommunications and utility piping systems
- Industrial process piping systems
- Municipal pressure and gravity piping systems
- Plumbing and mechanical piping systems
- Electrofusion systems for gas and water
- Industrial, plumbing and electrical cements
- Irrigation systems
- PVC, CPVC, PP, PVDF, PE, ABS, and PEX pipe and fittings

Products are manufactured by IPEX Inc.
NovaForm™ is a trademark of IPEX Branding Inc.

Email: novaform@ipexna.com
Toll Free: 866 473-9462
ipexna.com

IPEX by aliaxis

GSPECSNOVAFORM2023