SECTION 330130.79 - FOLD-AND-FORM PIPE LINING

This section specifies relining of sanitary sewer piping and associated preparatory work using the fold-and-form technique.

This section includes performance, proprietary, and descriptive type specifications. Edit to avoid conflicting requirements.

1. GENERAL
   * + 1. SUMMARY
          1. Section Includes:

Cleaning and flushing of existing sanitary sewers.

Taking video of existing sewers and their condition.

Installing fold-and-form pipe liner.

Installing deformed polyethylene pipe liner.

Reestablishing service connections.

* + - 1. DESCRIPTION
         1. The Work of this Section consists of operations, equipment, methods and materials necessary to clean, inspect by television, and rehabilitate underground sanitary sewer piping indicated on the Contract Drawings. Rehabilitation shall be by the following method at the option of the Contractor:

Use of a formed-in-place, full length, fold and form PVC pipe liner.

* + - * 1. Related Requirements:

List other Sections directly related to or affecting Work of this Section. Include Sections specifying information expected to be found in this Section as well as Sections required to describe complete system or assembly requirements.

Section 036000 - Grouting: Grout as required by this Section.

Section 312316 - Excavation: Excavating for utilities.

Section 330130.11 - Television Inspection of Sewers: TV inspection of pipeline and preparatory activities.

Section 330505.33 - Infiltration and Exfiltration Testing: Testing of deformed pipe liner.

Section 330505.41 - Air Testing: Testing of deformed pipe liner.

Section 330505.43 - Mandrel Testing: Testing of deformed pipe liner.

* + - 1. REFERENCE STANDARDS

List reference standards included within text of this section, with designations, numbers, and complete document titles. Edit reference standards list to include only those applicable to the project.

* + - * 1. ASTM International:

ASTM D256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics.

ASTM D638 - Standard Test Method for Tensile Properties of Plastics.

ASTM D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

ASTM D1693 - Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics.

ASTM D1784 - Standard Classification System and Basis for Specification for Rigid Polyvinyl Chloride (PVC) Compounds and Chlorinated Polyvinyl Chloride (CPVC) Compounds

ASTM D1785 - Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120.

ASTM D2122 - Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings

ASTM D2152 - Standard Test Method for Adequacy of Fusion of Extruded Polyvinyl Chloride (PVC) Pipe and Molded Fittings by Acetone Immersion

ASTM D2444 - Standard Practice for Determination of the Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight)

ASTM D2837 - Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products.

ASTM D3350 - Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.

ASTM D5260 - Standard Classification for Chemical Resistance of Polyvinyl Chloride (PVC) Homopolymer and Copolymer Compounds and Chlorinated Polyvinyl Chloride (CPVC) Compounds.

ASTM F1533 - Standard Specification for Deformed Polyethylene (PE) Liner.

ASTM F1606 - Standard Practice for Rehabilitation of Existing Sewers and Conduits with Deformed Polyethylene (PE) Liner.

ASTM F1867 - Standard Practice for Installation of Folded/Formed Polyvinyl Chloride (PVC) Pipe Type A for Existing Sewer and Conduit Rehabilitation.

ASTM F1871 - Standard Specification for Folded/Formed Polyvinyl Chloride Pipe Type A for Existing Sewer and Conduit Rehabilitation.

* + - 1. COORDINATION
         1. Coordinate Work of this Section with users connected to system.
         2. Notify Director’s Representative at least [**48**] hours in advance of expected disruption of sanitary service.
         3. Notify private sanitary sewer users at least <**48**> hours in advance of expected disruption of sanitary service.

Edit Paragraphs below to meet project requirements. Coordinate with NYSOGS PM.

* + - * 1. Limit disruption of service to the Facility to one-time occurrence for maximum of [**eight**] hours.
        2. Do not disrupt sewer service between hours of [**5:00**] PM and [**8:00**] AM unless otherwise indicated by the Director’s Representative
        3. Provide and maintain temporary facilities, including piping and pumps, to meet requirements.
      1. PREINSTALLATION MEETINGS
         1. Meet with the Director’s Representative a minimum [**one week**] [**<\_\_\_> weeks**] prior to commencing Work of this Section.
      2. SUBMITTALS

Only request submittals needed to verify compliance with project requirements.

* + - * 1. Submittals in this section are subject to the re-evaluation fee identified in Article 4 of the General Conditions.
        2. Manufacturer’s installation instructions shall be provided along with product data.
        3. Submittals shall be provided in the order in which they are specified and tabbed (for combination submittals).
        4. Product Data:

Manufacturer’s technical data, details, and specifications giving information on material composition, physical properties, and dimensions, including certification by the manufacturer that the materials are immune to corrosion from sewage and products resulting from the biological and chemical conversion of sewage constituents.

Manufacturer’s recommended procedures for handling, storing, and installation of the liner, including reinstatement of lateral service connections.

* + - * 1. Shop Drawings:

Indicate liner dimensions for each pipe size to be relined.

Details of the lining procedure, lining elements and equipment depicting method of installation.

* + - * 1. Design Calculations:

For the rehabilitation of sewers by the inversion and curing of a resin-impregnated tube, submit structural design calculations and specification data sheets listing all parameters used in the liner design and thickness determinations based on Appendix X1 of ASTM F 1216.

Calculations shall be prepared under and stamped by a Professional Engineer licensed in the State of New York. Submit P.E. Certification form for all CIPP and Fold-and-Form Liner design data.

Include following paragraph to submit physical samples to select finish, color, texture, and other properties.

* + - * 1. Samples: Submit [**two**] samples of liner material.
        2. Digital Video Discs (DVDs) or USB Drive:

Submit video recordings of piping sections as follows:

Show condition of existing pipe and pipe joints and location of existing service connections after cleaning and prior to relining.

Show liner and reestablished service connections after relining Work has been completed.

Pre- and Post- CCTV inspection shall be completed in accordance with Section 330130.11 - Television Inspection of Sewers.

* + - * 1. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

Include separate paragraphs for additional certifications.

Include following paragraph when contractor is responsible for designing products or assemblies. List affected products when section specifies more than one product.

* + - * 1. Delegated Design Submittals: Submit Shop Drawings signed and sealed by a New York State licensed engineer with design calculations and assumptions for liner thickness.
        2. Test and Evaluation Reports: Submit reports certifying that liner material meets ASTM testing standards as specified in this Section.
        3. Manufacturer Instructions:

Submit detailed description of liner placement and installation procedures.

Include description of procedures for sealing liner material at manholes and reestablishing service connections.

Submit manufacturer's requirements for receiving, handling, and storage of materials.

* + - * 1. Source Quality-Control Submittals:

Test Reports: Furnish certified test data issued by an independent testing laboratory, demonstrating that the products used comply with the required physical properties.

Workers’ Qualifications Data:

Submit the names and addresses of three (3) previous trenchless sewer rehabilitation projects comparable in all ways to this project. Briefly describe the nature of each project.

Submit a letter certifying that the Supervisor and the Workers doing the liner Work have at least 2 year’s experience each in installing sewer liners of the type specified.

* + - * 1. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
        2. Qualifications Statements:

Coordinate following subparagraphs with requirements specified in qualifications article.

Submit the names and addresses of 3 previous trenchless sewer rehabilitation projects comparable in all ways to this project. Briefly describe the nature of each project.

Submit a letter certifying that the Supervisor and the Workers doing the liner Work have at least 2 years’ experience each in installing sewer lines of the type specified.

Submit manufacturer's approval of installer.

* + - 1. CLOSEOUT SUBMITTALS
         1. Project Record Documents: Record actual locations of each service connection.
      2. QUALITY ASSURANCE

Include this article to specify compliance with overall reference standards affecting products and installation included in this section.

Include following paragraph only when cost of acquiring specified standards is justified.

* + - * 1. Maintain [**copy**] [<\_\_> **copies**] of each standard affecting Work of this Section on Site.
      1. QUALIFICATIONS

Coordinate following paragraphs with requirements specified in submittals article.

* + - * 1. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum [**three**] years' [**documented**] experience.
        2. Installer: Company specializing in performing Work of this Section with minimum [**three**] years' [**documented**] experience in installation of liner materials [**and licensed or certified by manufacturer**].
        3. Licensed Professional: New York State licensed professional Engineer experienced in design of specified Work.
        4. Pipeline Assessor:

Person specializing in assessing condition of sewer pipelines prior to and following relining.

Currently certified in Pipeline Assessment and Certification Program (PACP) of the National Association of Sewer Service Companies (NASSCO). Typically NYSOGS will hire an independent Inspector. Confirm with NYSOGS Project Manager.

* + - * 1. Inspector:

Director’s Representative will provide a qualified inspector specializing in sewer pipeline rehabilitation.

Currently certified in Inspector Training and Certification Program (ITCP) of NASSCO.

* + - 1. DELIVERY, STORAGE, AND HANDLING
         1. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
         2. Store materials according to manufacturer instructions.
         3. Protection:

Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.

Provide additional protection according to manufacturer instructions.

* + - 1. EXISTING CONDITIONS
         1. Field Measurements:

Verify field measurements prior to fabrication.

Indicate field measurements on Shop Drawings.

* + - 1. WARRANTY

This article extends warranty period beyond one year. Extended warranties may increase construction costs and States’ enforcement responsibilities. Specify warranties with caution.

* + - * 1. Furnish [**two**]-year manufacturer's warranty for liner.

1. PRODUCTS
   * + 1. PERFORMANCE, MATERIAL, AND DESIGN CRITERIA
          1. Design lining material to have sufficient structural strength to support dead loads, live loads, and groundwater load imposed, assuming existing pipe cannot share loading or contribute to structural integrity of liner.
          2. Design liner to least-possible thickness to minimize decreasing interior pipe diameter.
          3. Design liner material to provide jointless, continuous, and structurally sound construction able to withstand imposed static, dynamic, and hydrostatic loads on a long-term basis.
          4. Identify design provisions for shrinkage control to prevent future misalignment of service reconnections.
          5. Characteristics: Designed to meet the following installation conditions:

To match the configuration of the host pipe with a concave dimple appearing at each service connection.

Able to negotiate pipeline bends of 90 degrees without splitting, rupturing, or wrinkling of the liner material.

Able to be expanded 25 percent larger than the host pipe diameter without splitting or rupturing of the liner material.

ASTM D 1784 impact resistance equal to 5 or better.

Manufactured with sufficient excess wall thickness to allow the liner to meet or exceed the DR requirements after being expanded during final installation.

Continuously extruded or produced at the factory to effectively span the distance between manholes with no joints therebetween.

* + - * 1. Material Testing: Provide certification of inspection and testing at time of manufacture for defects in accordance with ASTM D 2122, D 2152, and D 2444. Liners shall be homogeneous, uniform in color, free of cracks, holes, foreign material, and deleterious faults.
      1. FOLD-AND-FORM PVC PIPE LINER
         1. Fold-and-Form PVC Liner:

Formulated polyvinyl chloride compound manufactured from virgin PVC resins, with no fillers, and meeting the following minimum physical properties:

Flexural Modulus: 145,000 psi @ 73 degrees F.; ASTM D 790.

Flexural Strength: 4100 psi @ 73 degrees; ASTM D 790.

Izod Impact: 15 ft.-lb./in.; ASTM D 256.

Chemical Resistance: C; ASTM D 1784.

Combustibility: Self-extinguishing.

Standard Dimension Ratio (SDR): 35.

Marked at maximum 5-foot intervals indicating ASTM D 1784 cell classification, manufacturer, and size (diameter and SDR).

* + - * 1. [Manufacturers](http://www.specagent.com/LookUp/?ulid=13264&mf=04&src=wd):

Flow-Liner Systems LTD.

Maxliner USA.

Approved equivalent.

Insert descriptive specifications below to identify project requirements and to eliminate conflicts with products specified above. Include configuration, size, color, material composition, and other properties needed to describe product.

* + - * 1. Description:

Comply with ASTM F1871.

Effective Length: Match length of piping to be lined.

Sealer: As recommended by liner manufacturer.

* + - * 1. Materials:

PVC compound meeting or exceeding requirements for Cell Classification 12111 as defined in ASTM D1785.

Limit additions and fillers, including stabilizers, antioxidants, lubricants, colorants, **[and] <\_\_>**, to 20 parts or less for each 100 by weight of PVC resin in compound.

* + - 1. DEFORMED POLYETHYLENE PIPE LINER
         1. [Manufacturers](http://www.specagent.com/LookUp/?ulid=13265&mf=04&src=wd):

Flow-Liner Systems LTD

Approved equivalent.

Insert descriptive specifications below to identify project requirements and to eliminate conflicts with products specified above. Include configuration, size, color, material composition, and other properties needed to describe product.

* + - * 1. Description:

Maximum Initial Standard Dimension Ratio (SDR): [**32.5**].

Effective Length: Match length of piping to be lined.

* + - * 1. Materials:

Polyethylene (PE):

Comply with ASTM D3350 cell classification 345434C or D.

Comply with ASTM F1533 and F1606.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

High-Density Polyethylene (HDPE):

Comply with ASTM D3350 cell classification 345434E.

Tensile Strength (Break):

4,500 psi

Comply with ASTM D638.

Tensile Strength (Yield):

3,200 psi

Comply with ASTM D638.

Impact Strength:

3.0 ft.-lb./in.

Comply with ASTM D256, Test Method A.

Flexural Modules:

136,000 psi

Comply with ASTMD790.

Sealer: As recommended by liner manufacturer.

* + - 1. MIXES
         1. Grout: As specified in Section 036000 - Grouting.

Use following article for deformed PE pipe liners.

* + - 1. SOURCE QUALITY CONTROL
         1. Inspection and Testing:

Inspect each lot of liner for defects and test according to ASTM D1693 and ASTM D2837.

Verify that liner is homogeneous throughout, uniform in color, and free of cracks, holes, foreign materials, blisters, or deleterious faults.

Marking:

For testing purposes, mark each production lot with identical marking number.

Mark liner at 5-foot intervals or less with coded number identifying manufacturer, SDR, size, material, date, and shift when liner was extruded.

At end of production shift during extrusion, change marking code to indicate where new production shift started.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

Use following article for fold-and-formed PVC pipe liners.

* + - * 1. Inspection and Testing:

Inspect extruded material for defects and physical properties according to ASTM D1785.

Verify that liner material is homogeneous and free of defects, cracks, holes, blisters, protrusions, foreign materials, or other deleterious faults.

Marking:

For testing purposes, mark each production lot with identical marking number.

Mark each reel of folded PVC pipe at intervals not to exceed 5 feet with coded number identifying manufacturer, size, cell class, machine, shift, and date when liner was extruded.

Chemical and Physical Testing: Test cured samples according to ASTM D5260.

Include one or both of following paragraphs to require Director’s Representative’s inspection or witnessing of test at factory.

* + - * 1. Director’s Representative Inspection:

Make liner products available for inspection at manufacturer's factory prior to packaging for shipment.

Notify Director’s Representative at least [**seven**] days before inspection is allowed.

* + - * 1. Director’s Representative Witnessing:

Allow witnessing of factory inspections and tests at manufacturer's test facility.

Notify Director’s Representative at least [**seven**] days before inspections and tests are scheduled.

Include following paragraph if reliance on manufacturer's approved quality-control program is sufficient for project requirements.

* + - * 1. Certificate of Compliance:

If manufacturer is approved by the Director’s Representative, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.

Specified shop tests are not required for Work performed by approved manufacturer.

1. EXECUTION
   * + 1. EXAMINATION
          1. Verify location of piping to be relined.
       2. PREPARATION
          1. Cleaning: Clean existing sewer pipes of debris, sedimentation, and mineral deposits with high-velocity cleaner, bucket and scraper, root saws, rolling or balling units, [**or**] <**\_\_\_\_\_\_\_\_**>.
          2. Initial Video Inspection and Repair:

Conduct closed-circuit video inspection as specified in Section 330130.11 - Television Inspection of Sewers.

Determine condition of existing piping, degree of offset of joints, and locations of crushed walls and obstructions.

Determine sizes and locations of service entrances and connections.

Evaluation of pipe conditions performed by pipeline assessor.

Inspection of Work performed by a NASSCO ITCP-certified inspector. Coordinate inspection work to be provided by the Director’s Representative.

Clear obstructions, service piping protrusions, and other materials from bottom of existing pipe to ensure that inserted pipe liner directly contacts existing pipe wall.

* + - * 1. Bypassing Sewage:

Set up bypassing pump system to isolate each section of piping for relining.

Maintain bypass pumping until lining is totally formed and service connections have been reestablished.

* + - 1. INSTALLATION
         1. Excavate for point repairs only on emergency basis and as permitted by the Director’s Representative.
         2. Perform relining and reestablish service connections without need for excavation while minimizing disruptions to [**adjacent occupied buildings and traffic**].
         3. Deformed Polyethylene (PE) Pipe Liner:

Confirm access points with the Director’s Representative.

Pulling of Liner:

Pull liner through existing pipe through access points or using existing manholes.

Use appropriate sleeves and rollers to protect liner.

After deformed pipe liner is in place, cut pipe to length and attach processing manifolds at both pipe ends.

Attach temperature- and pressure-measuring instruments to deformed pipe at both ends.

Liner Forming:

Use steam and air pressure to re-form pipe to conform to existing pipe wall.

Gradually re-form pipe following manufacturer instructions.

Cool-Down: Cool re-formed pipe according to manufacturer recommendations.

Install finished lining continuous over entire length of piping free of visual defects, including foreign inclusions, pinholes, and delamination.

Test for leakage as specified in FIELD QUALITY CONTROL Article to confirm that lining is impervious and free of leakage from pipe to surrounding ground or from ground to inside of lined pipe.

Repair defects affecting integrity or strength of lining.

Verify that no gap or annular space exists between finished liner and existing sewer main observed at manholes, sewer service connections, or other exposed points within finished lined section.

Grout annular space to prevent damage to or collapse of liner or service connection.

Pump grout into annular space at manholes, sewer service connections, and where liner is exposed.

Seal new pipe liner watertight to rehabilitated piping at both ends, using sealing material compatible with pipe.

* + - * 1. Fold-and-Formed Pipe Liner:

Comply with ASTM F1867.

Apply steam heat to make folded pipe pliable.

Pull pliable folded pipe into place, not exceeding pulling force of 2,000 lbf..

After folded pipe is inserted into existing pipe, cut off pipe at starting point, restrain pipe at terminating point, and introduce steam at insertion end inside folded pipe until minimum desired temperature is attained at terminating end.

Rounding:

After material has reached manufacturer's recommended temperature, insert and pull specifically designed pressure-driven rounding device through folded PVC.

Do not exceed manufacturer's insertion rate and pressure.

Prevent scraping, tearing, abrasion, movement, or other damage to liner.

Begin rounding process at starting manhole and progressively proceed to terminating manhole to force out liquid between existing pipe and liner, including sewage, groundwater [**, and**].

After rounding, apply air pressure according to manufacturer instructions.

After air pressure, introduce water until system is completely filled, then cool pipe and cut off both ends.

Verify that no gap or annular space exists between finished liner and existing sewer main observed at manholes, sewer service connections, or other exposed points within finished lined section.

Grouting:

Grout annular space to prevent damage or collapse of liner or service connection.

Pump grout into annular space at manholes, sewer service connections, and wherever liner is exposed.

Sealing:

Seal new PVC liner watertight to host pipe in order to prevent water movement between two systems.

Use end seal material compatible with PVC liner.

* + - * 1. Service Connections:

Reestablish existing sewer service connections through use of closed-circuit television camera and remote-controlled cutting device.

Match invert of reestablished service with previously existing invert.

Maintain minimum of 95 percent to maximum of 100 percent of original service connection opening.

Reestablish sewer service connection with uniform cuts free of burrs and sharp edges.

After reestablishing service connection, flush piping clean.

* + - 1. FIELD QUALITY CONTROL
         1. Testing of Pipe Liner:

As specified in Section [**330505.33 - Infiltration and Exfiltration Testing**] [**330505.41 - Air Testing**] [**330505.43 - Mandrel Testing**].

* + - * 1. Manufacturer Services: Furnish services of manufacturer's representative experienced in installation of products furnished under this Section for not less than [**days**] [**hours**] on Site for installation, inspection, and field testing.
        2. Equipment Acceptance:

Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.

If liner fails to re-form, remove failed liner and install new liner.

Conduct closed-circuit video inspection of completed relining Work, indicating no visual defects, including foreign inclusions, dry spots, pinholes, cracks, or delamination.

Confirm that service connections are complete and unobstructed.

No infiltration of groundwater is permitted.

Make final adjustments to liner under direction of manufacturer's representative.

* + - * 1. Furnish installation certificate from equipment manufacturer's representative attesting that liner has been properly installed and is ready for startup and testing.

END OF SECTION 330130.79