

SECTION 00413 – GLASS REINFORCED PLASTIC (GRP) CURED-IN-PLACE PIPE (CIPP)

Description

00413.00 Scope - This section specifies the rehabilitation lining of the storm sewer lines shown on the drawings.

Contractor shall provide and install a resin impregnated glass reinforced material tube with styrene blocking inner and outer foils and a wearing surface of inner pure resin layer in all sewers identified for cured-in-place-pipe (CIPP) lining in accordance with American Society for Testing and Materials (ASTM) F2019 for the pulled-in-place and UV-cured installation method.

The existing pipe is a spiral wound aluminized steel pipe with a severely deteriorated invert that is currently exposed to the potential intrusion of exterior groundwater which has not been verified. The Contractor is responsible for insuring the CIPP product can be properly installed under conditions that may not be entirely dry if after diverting all upstream flows, groundwater is still present in the host pipe.

00413.01 Submittals - Submit the following, this section replaces Section 00410.03 of the Standard Specifications.

1. Shop drawings which detail short and long term properties (providing all supporting test data) of all component materials and construction.
2. Recommendations for material storage, CIPP liner handling, insertion, curing, trimming and finishing.
3. Structural calculation for each CIPP liner size with recommended thicknesses based upon minimum physical properties in Table 1 of ASTM F2019. Values greater than this for flexural strength and flexural modulus may be used at the discretion of the Contractor. Verification of final thickness and physical properties will be determined in accordance with 00413.71. Consequences for failure to reach the submittal strength are outlined in 00413.91.
4. Liner system manufacturer's calculations for the volume of resin to be used for each segment including the calculated amount of excess resin necessary to achieve full saturation. The volume calculations must be based on required finished liner characteristics and should account for tube void space, the structural condition of the host pipe and predicted changes in the resin's physical and chemical characteristics due to polymerization.
5. The methods and equipment used to reinstate connecting sewers or manholes.

6. Flow diversion plan for the mainline. This will include a specific plan for each individual manhole section which identifies location of bypass pipe, method of discharging against the curbline where shown on the plans, crossing street intersection, pumping capacity and location of equipment within the street.
7. Detailed method for addressing sampling requirements.
8. CCTV Inspection reports as specified in subsection 00413.40.
9. Manufacturer's recommended installation procedures.
10. Certification showing the Contractor is currently licensed by the appropriate licensor to perform CIPP installation. Certification shall be given to Owner before any materials are delivered to the job site.
11. Certification stating CIPP tube has been manufactured in accordance with ASTM F2019 and that resin is suitable for its intended use.
12. Testing for chemical resistance shall be performed on a previously prepared sample of the finished product, equivalent to that proposed for this project. A certified affidavit, signed by an officer of the company, shall be provided stating that the resin the tests apply to and the resin submitted for this project are the same.
13. Test report of CIPP sample(s) and tests.
14. Manhole connection details.
15. CIPP liner terminations.
16. Material safety data sheets for all hazardous chemicals used or expected to be on-site.

Materials

00413.10 General - Contractor shall furnish CIPP tubing that meets the following requirements:

- (a) All materials and installation procedures provided by the Contractor for use in the CIPP installation process shall be equal to or exceed the requirements of Sections 5 and 6 of ASTM F2019.
- (b) Wrinkles in the finished liner pipe which reduce the hydraulic capacity of the pipe (wrinkles which exceed 5 percent of the pipe diameter) are unacceptable and shall be removed or repaired by the Contractor at no additional cost to Owner. Wrinkles in the finished liner pipe that reduce the structural stability of the pipe are unacceptable. Methods of repair shall be proposed by the Contractor and submitted to Owner for review.

(c) Contractor shall be responsible for control of all material and process variables to provide a finished CIPP possessing the minimum properties specified in ASTM F2019 and supplemented herein.

00413.11 Manufacturers – Approved CIPP liner manufacturers are BKP Berolina, Lightstream or equivalent.

00413.12 Contractors - The employees of the licensed Contractor, or installation Subcontractor, shall have acceptable CIPP lining experience for sewers from 8 inches up to and including 36 inches in diameter. The Superintendents of Contractor shall have cumulatively successfully completed at least 75,000 linear feet of UV-cured, fiberglass, CIPP.

00413.13 Component Properties –

(a) Tubing: The tubing material shall be free from tears, holes, cuts, foreign materials and other surface defects.

(b) Resins: Resins shall meet the requirements of ASTM F2019, Section 5.2.4 and be appropriate for conditions encountered.

00413.14 Finished and Cured CIPP Liner Properties – Furnish liners that have the minimum physical properties stated in ASTM F1216 and ASTM F2019.

(a) The physical properties of the cured CIPP shall have minimum initial test values as given in Table 1 of ASTM F2019 (and supplemented below in Table 1) for polyester, vinylester, and epoxy resins. Properties for these or any other enhanced resins shall be substantiated with test data.

Test Property	Test Value	Test Method
Initial Flexural strength	6,500 psi	ASTM D790
Initial Flexural modulus	725,000 psi	ASTM D790

00413.15 Dimensions – Furnish Liners that have the minimum dimensional properties.

(a) Contractor shall field verify pipe diameters and lengths prior to ordering liner tubes.

(b) The minimum length shall be that which continuously spans half the distance from the center of the inlet manhole to the next manhole, plus the liner overlap. The Contractor shall verify the lengths in the field before the felt tube is cut and

impregnated. Individual installation runs may include one or more manhole-to-manhole sections as approved by Owner.

- (c) It is the Contractor's responsibility to determine the required diameter of the liner.
- (d) The nominal wall thickness shall be the calculated design thickness based upon Table 1 values, or alternative thickness based upon Contractor submitted values.

00413.16 Design Criteria - Contractor shall furnish CIPP tubing that meets the following design criteria.

- (a) The liner shall be designed in accordance with the standards of ASTM F 2019, Appendix X1 and these specifications. All material properties used in design calculations shall be long-term (time-corrected) values. Contractor shall familiarize himself with site conditions when preparing liner design.
- (b) Contractor shall calculate the required minimum thickness for each pipe and meet the following conditions and parameters:

Condition Parameter

Service Life	Greater than 50 year
Pipe Condition	Fully deteriorated

Load Conditions

Soil	120-pounds/cubic foot
Traffic	H20-Highway
Groundwater Elevation	At surface (Depth per plan)
Design Thickness.....	Calculate and express this thickness as the absolute minimum thickness that will be acceptable using physical properties found in Table 1. (Minimum thickness allowed for 48-inch pipe is 18.0mm) Greater physical values may be used at the option of the Contractor to be verified with final material testing results in 00413.71.
Pipe Ovality.....	Per Contractor's review of CCTV Inspection (assumed 2%)
Modulus of Soil Reaction...	1000 psi
Enhancement Factor.....	7
Long-term Flexural Strength..	50% of initial (ASTMD 790)
Modulus of Elasticity	50% of initial (ASTM D 790)
Maximum Deflection	5%
Minimum Factor of Safety...	2.0
Resin Migration Allowance...	10% maximum
Allowable Deformity.....	3%

Design the CIPP wall thickness to withstand all imposed loads, including live loads and if applicable, hydrostatic pressure. Include considerations for ring bending, deflection, combined loading buckling and ovality in the design of the CIPP.

00413.17 CIPP Termination Points - The Contractor shall provide CIPP liner terminations. Liner termination method shall be submitted and approved by Owner prior to installation of the lining system.

00413.18 Pipe Penetrations by Storm Drain Laterals - Structural epoxy adhesive and repair mortar to seal connection between the lateral and new CIPP pipe shall be Sikadur[®]-31 or approved equal.

Construction

00413.40 Preparatory Procedures:

(a) **Storm Sewer Cleaning:** Prior to CIPP tube installation, the Contractor shall clean the existing sewer and dispose of the debris. The Contractor shall clear the existing sewer of obstructions such as solids or collapsed pipe that will prevent or hinder CIPP liner installation.

(b) **Bypass Pumping:**

1. The Contractor shall provide bypass pumping and/or diversion for acceptable completion of the liner installation. Bypass pumping shall consist of furnishing, installing, and maintain all power, primary pumps, appurtenances and bypass piping required to maintain existing flows. No flow that will negatively affect the liner shall be allowed in pipe during CIPP installation.
2. Bypass pumping shall be done in such a manner as to not damage private or public property, or create a nuisance or public menace. The pumped storm water shall be in an enclosed hose or pipe that is adequately protected from traffic, and shall be redirected into the downstream storm drain system along the curb line. All bypass piping on shall have traffic rated fully enclosed ramps specifically designed for this type installation across West Harvard Avenue.
3. The Contractor shall take all necessary precautions to insure that no private residences or properties are subjected to receiving any of the bypassed storm water. After the work is completed, flow shall be restored to normal.

(c) **TV Inspection and Line Obstructions:** Experienced personnel trained in locating breaks, obstacles and service connections by visual inspection shall perform inspection of the storm sewer main. The interior of the sewer shall be carefully inspected to determine the location of conditions, which may prevent proper installation of CIPP. Contractor shall furnish television inspection report material to Owner.

- (d) Measurement: It is the Contractor's responsibility to measure the actual inside diameter at different locations of the storm sewer to determine the appropriate size of CIPP liner to use.
- (e) Spot Repair: Any holes, cracks, structural defects, pipe misalignments, pipe connections, visible leaks or voids that prevent the proper installation of the CIPP liner excuse Contractor from lining the subject line.

00413.41 Installation Procedures:

- (a) General: UV-cured CIPP according to ASTM F2019 shall be "wet-out" only at the manufacturer's plant. The impregnated liner shall be stored, transported and installed in accordance with the manufacturer's recommendations.
- (b) Installation Process: No CIPP installations will be undertaken in weather conditions that could jeopardize the installation of the CIPP, or be detrimental to the long-term performance of the CIPP. The liner will be installed by the pull-in method as described in 6.2.1 and 6.2.2 of ASTM F2019.
- (c) Curing: The curing shall follow the manufacturer's recommendations and 6.7 in ASTM F2019.

00413.42 Finished Product:

- (a) The finished CIPP shall be continuous over the entire length of an installation run.
- (b) Defects such as foreign inclusions, dry spots, pinholes, delamination, seam separation and wrinkling beyond the specification allowances in 00413.10, affecting the integrity or strength of the CIPP, or as adversely affecting the hydraulic capacity of the CIPP, shall be repaired or replaced at the Contractor's expense.
- (c) The Contractor shall provide a seal, as may be recommended by the lining manufacturer, at the service connection so that no leakage of fluids may infiltrate between the liner and the existing sewer surface.
- (d) Inspection: The Contractor shall inspect the CIPP after installation. The inspection will be performed and recorded using closed circuit television equipment. If defects or voids exist, the Contractor shall repair or replace that section of the pipe at no additional cost to Owner. Methods of repair shall be submitted by the Contractor and approved by Owner prior to any repairs to be made.

Finishing, Cleaning Up and Testing

00413.70 Cleanup - Following inspection, the Contractor shall clean up the entire project area. The Contractor shall dispose of all excess material and debris not incorporated into the permanent installation off site.

00413.71 Material Sampling and Testing - This section contains references to ASTM F2019 (*The Rehabilitation of Existing Pipelines and Conduits by the Pulled in Place Installation of Glass Reinforced Plastic (GRP) Cured-in-Place Thermosetting Resin Pipe (CIPP)*). In case of conflict between the requirements of this section and those of ASTM F2019, the requirements of this section shall prevail.

(a) CIPP Liner Samples:

1. **Sample Preparation:** The Contractor shall prepare samples of the installed CIPP liner for subsequent testing of its physical properties. Contractor shall cut two samples of as yet uncured for each diameter of liner being installed. Contractor shall place the uncured liner between two sheets of plexiglas and cause the liner to cure. The samples shall be identified by: Date, Project Name, Size, Thickness and Resin. Contractor shall split the liner samples with the construction manager who will keep one sample for future reference.
2. **Sample Testing:** The cured sample shall be tested by an independent testing laboratory, as recommended by the CIPP liner manufacturer and approved by Project Manager, for the bending and tensile properties, as per ASTM D790 and ASTM D638 respectively. Chain of custody documentation shall be required for the samples tracing their movement from the field to the testing lab. Final payment will not be made until test results are received. The Contractor shall be responsible for any deviation from the specified physical properties and those evaluated through testing. Failure to meet the specified physical properties may result in the CIPP liner being considered defective work that will be handled in accordance with the Contract. The Contractor shall be responsible for all costs associated with the testing of the liner physical properties.

(b) Wall Thickness: The method of obtaining the CIPP wall thickness measurements shall be in a manner according to ASTM F2019 7.1.4 and consistent with 8.1.2 of Specifications D5813. The average thickness shall be calculated using all measured values and shall meet or exceed minimum design thickness as agreed between purchaser and seller. The minimum wall thickness at any point shall not be less than 87.5 % of the average specified design thickness as agreed between purchaser and seller.

(c) CIPP Liner Handling: Contractor shall exercise adequate care during transportation, handling and installation to ensure that the CIPP material is not torn, cut, or otherwise damaged. If any part or parts of the CIPP material becomes torn, cut or otherwise damaged before or during insertion, it shall be repaired or replaced in accordance with the manufacturer's recommendations and approval by Owner before proceeding further and at the Contractor's expense.

(d) Conformance Standards and Remedies: The finished product must meet or exceed the following:

1. No radially positioned (perpendicular to flow) wrinkles, fins or other discontinuities in the lower third of the pipe which exceed ½ inches in height, or more than 3 percent of the host pipe inside diameter.

2. No radial wrinkles, fins or other discontinuities in the upper two-thirds of the pipe having a height of 5 percent or more of the host pipe inside diameter, unless approved.
3. No leakage through the liner.
4. No separation of the liner from the existing pipe.
5. No delamination of the UV-CIPP layers
6. If an installed liner has unacceptable wrinkles, fins, leakage, delamination, pinholes, soft spots, blisters, failed tests, or other defects, remedy the defect by installing a second liner, removing and re- installing a full-thickness liner, constructing a full pipe replacement, or installing a liner repair as approved.

00413.75 Warranty - The Contractor shall warrant each pipe lined with the specified product against defects in materials, surface preparation, lining application, and workmanship for a period of 24 months from the date of final acceptance of the project.

- (a) The Contractor shall, within one month of written notice thereof, repair defects in materials or workmanship that may develop during said 24-month period. Defects shall be defined as: evidence of visible leakage of groundwater through the CIPP system, delamination of any portion of the CIPP system as visible from CCTV inspection, or separation of any part of the CIPP system from the host pipe to the extent that the CIPP system inside diameter in the separated area is 95 percent or less of the completed CIPP system inside diameter. The Contractor shall also repair any damage to other work, damage to buildings, houses or environmental damage caused by the backup of the storm runoff because of the failure of the lining system; or repairing of the same.
- (b) Repairs shall include removal of the existing liner and re-lining if possible, or excavation and replacement of the section of pipe where the defect occurs.

Measurement

00413.80 Measurement:

(a) CIPP Liner, 48-Inch (UV Cure)

1. Measurement shall be on a linear foot basis for 48-inch diameter rehabilitation as measured from center of manhole to center of manhole.
2. Payment shall include complete compensation for all work, labor, materials, equipment and incidentals necessary to provide Cured-in-Place Pipe (CIPP) using UV cure (ASTM F1216 and F2019) in place and approved for use. This will include, but is not limited to pre-installation video inspection and cleaning along with post-installation video inspection.

No separate or additional payment will be made for additional testing, dewatering, cleaning and video inspection required as a result of correction of unsatisfactory work.

Payment

00413.90 Payment – The accepted quantities of work performed under this Section will be paid for at the Contract lump sum price per CIPP diameter for the following items:

PAY ITEM	UNIT OF MEASURE
(a) 48-Inch Diameter CIPP Liner (UV Cure).....	Linear Foot

Payment will be made in full for furnishing and placing all materials, and for furnishing all equipment, labor, dewatering and incidentals necessary to complete the work as specified.

00412.91 Payment Deduction:

- (a) Payment will be based upon the Contract Unity Price and test results acquired in accordance with 00413.71(a) and (b). Should test results fail to meet the specified design parameters for thickness and initial modulus of elasticity, yet comply with Conformance Standards in 00413.71 (d), a payment deduction will be made according to the Payment Formula below:

$$\text{Payment} = \text{Length Installed} \times \text{Contract Unit Price} \times (\text{actual safety Factor}/\text{Design Safety Factor})$$

The Actual Safety Factor will be calculated using the governing design equations (i.e. equations yielding the greatest minimum thickness) from ASTM F1216-Appendix X1. The measured thickness, measured flexural strength and measured initial flexural modulus will be substituted for their respective design values while the remaining parameters specified 00413.16 are held constant. The Design Safety Factor is 2.0.

No additional payment is made for CIPP exceeding required design safety factor. The CIPP will be considered Defective Work if the actual safety factor is below 1.0. The Owner reserves the right to require the Contractor to remove and replace it, at its sole discretion.

SECTION 00470 – MANHOLES, CATCH BASINS, AND INLETS

00470.41 Precast Concrete Manholes – Add the following to the end of the section:

- (d) **Submittals** – Suppliers of precast manholes to provide shop drawings showing the locations and grades of the pipe inlets and outlets.

00470.45 Steps and Ladders – Delete this subsection as steps and ladders are not required.

00470.71 (a) Hydrostatic Testing – Delete this subsection in its entirety.

00470.90 Payment – Add the following pay item(s):

PAY ITEM	UNIT OF MEASURE
(a) 60-inch Concrete Storm Sewer manholesEach

SECTION 00490 – MANHOLES, CATCH BASINS, AND INLETS

00490.00 Scope - Add the following:

Connection of existing storm sewer pipe to new manholes or new structures and any fittings or appurtenances required to make the connection are considered incidental to other items of work under the Contract. The inverts of existing pipes are to be verified and field fit as required.

00490.90 Payment – Add the following:

UNIT OF MEASURE	PAY ITEM
(i) Connect New Pipe to Existing Pipe 48-inch.....	Each

In item (i) the size of pipe will be inserted in the blank. Item (i) includes payment for all required labor and fittings required to make connection between different sized and types of pipes.

SECTION 00495 - TRENCH RESURFACING

Comply with Section 00495 of the Standard Specifications modified as follows:

00495.40 General – Add the following bullet item:

(I) All open trenches within paved areas shall be paved with asphalt concrete to a depth of 7-inches from finished grade. Asphalt concrete shall be placed in 3 lifts with a maximum of 3-inches being placed per lift.