PART 1 GENERAL

1.01 SUMMARY

A. It is the intent of this specification to provide for the reconstruction of sewer pipes by the use of the Cured-in-Place Pipe (CIPP) process utilizing the trenchless method of installation of a resin-impregnated, flexible tube which is inverted into the existing sewer by hydrostatic head or air pressure and cured by means of heated water or ultraviolet (UV) light. When cured, the finished sewer lining shall be tight fitting and continuous from end to end.

B. The work included shall include, but not be limited to, mobilization, cleaning and televising the sewers (pre-lining CCTV inspection), removal of debris, bypass pumping, traffic control, inspection, installation of the Cured-in-Place Pipe, reconnection of all service and branch connections, restoration of the work area, testing and televising the sewer depicting the final product (post-lining CCTV inspection).

C. The Contractor shall review all inspection data and pipe video tapes provided by the Owner during the bidding phase of the project and consider this information during the formation of his bid. No claims for additional compensation will be considered by the Owner for conditions present and/or ascertainable from the Owner-supplied inspection data and pipe video tapes information.

1.02 PRICE AND PAYMENT PROCEDURES

A. Only those items indicated in the Proposal will be considered for payment. All other work necessary for the completion of the contract is incidental to the items indicated in the Proposal. The Owner will make no additional payments for items not included in the Proposal.

B. The Contract is based on unit price work or as itemized in the Proposal. Final measured quantities may vary from the amounts reflected in the Proposal.

C. Payment for the work included in this section will be in accordance with the prices quoted in the Proposal for the quantity of work performed. The pay quantity length for each segment shall be determined by use of a walking wheel, roll-a-tape, or other suitable device, and the accuracy shall be satisfactory to the Owner. Measurement shall be in linear feet along the centerline of the sewer from centerline of manhole structure to centerline of manhole structure. Measurements will be rounded up or down to the nearest whole foot increment. For a CIPP segment to be eligible for payment, the final length shall be agreed upon by all parties and CCTV videos must be submitted to the Owner for review and approval as described under CLOSEOUT SUBMITTALS below.

D. Final payment will be made upon finalization of the project including restoration, testing and acceptance of the CIPP.

E. Unless otherwise indicated in the Proposal, mobilization will not be paid for separately but is considered included for payment in other contract work pay items. Mobilization shall consist of, but not be limited to, costs associated with the movement of personnel, equipment,

supplies and incidentals to the project site. The Owner will not be responsible for any costs associated with travel expenses and hotel/motel rental.

F. Unless otherwise indicated on the Proposal form, Traffic Control will not be paid for separately but considered included for payment in other contract work pay items.

G. The Owner reserves the right to deduct payment from the Contractor for failure to meet CIPP design requirements. The Owner, depending on the severity of the defects, may elect to withhold payment entirely or to prorate a deduction based on the reduction of the Factor of Safety of the installed CIPP.

H. The cost associated with the removal and disposal of debris will not be paid for separately, but considered included for payment in other contract work pay items.

I. Unless otherwise indicated in the Proposal, bypass pumping will not be paid for separately but considered included for payment in other contract work pay items.

J. The work involved in preparing test samples required under QUALITY CONTROL below is considered incidental to other contract work pay items. Owner will pay for and conduct independent testing of Contractor supplied samples.

1.03 REFERENCES

A. Whenever reference is made to specifications other than those contained herein, said specifications shall apply. The following standards are made part of this specification by reference.

1. ASTM F 1216-07(b), Standard Practice for Rehabilitation of Existing Pipelines and Conduits by Inversion and Curing of a Resin-Impregnated Tube.

2. ASTM F 2019-03, Standard Practices for Rehabilitation of Existing Pipelines and Conduits by Pulled in Place Installation of Glass Reinforced Plastic Cured in Place Thermosetting Resin Pipe.

3. ASTM D 5813, Specification for Cured-in-Place Thermosetting Resin Sewer Pipe.

4. ASTM F 1743 – 96 (2003) Standard Practice for Rehabilitation of Existing Pipelines and Conduits by Pulled-in-Place Installation of Cured-in-Place Thermosetting Resin Pipe (CIPP).

5. Michigan Manual of Uniform Traffic Control Devices (M.M.U.T.C.D.), latest edition.

6. National Association of Sewer Service Companies (NASSCO) Pipeline Assessment and Certification Program® (PACP®).

1.04 ADMINISTRATIVE REQUIREMENTS

A. Notifications

1. The Contractor shall notify the Owner and all sewer users affected by the work a minimum of seven (7) days prior to beginning work. Notification shall be by means of a written notice on the Contractor's letterhead, delivered to each user and shall advise the user as to when sewer service will be interrupted and to minimize water usage during this period. The Contractor shall ensure that every user is so notified. Notification shall include telephone number(s) for contacting the Contractor at any time, day or night.

2. A second notice to the sewer users affected by the work shall be provided one working day prior to the installation of the CIPP.

3. The Contractor shall also provide a completion notice to each sewer user within 12 hours of completion of the work and restoration of the service connections.

B. Permits

1. Contractor shall submit and receive all required permits, including road right-of-way and hydrant permits, prior to the commencement of the work.

1.05 QUALITY ASSURANCE

A. The selected CIPP product must have a minimum of 100,000 lineal feet of successful sanitary sewer installations.

B. The Contractor shall be certified by the CIPP manufacturer that the equipment to be used has been approved by the manufacturer for the use intended and the Contractor's personnel have been trained on the proper installation of the CIPP product.

C. The Contractor shall only use skilled workmen who are thoroughly trained and experienced in CIPP installations and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this specification.

1.06 SUBMITTALS

A. Submittals shall be made a minimum of 30 days prior to starting the work and shall be approved by the Engineer.

B. Product data for each type of product specified.

C. Materials list of items proposed to be provided under this specification.

D. Manufacturer's specifications and other data needed to prove compliance with the specified requirements, including the following.

1. Fabric tube.
2. Resin.
3. Manufacturer's shipping and storage recommendations.
4. Manufacturer's Material Data Sheets (MSDS).

5. Fabric tube wet-out and curing method.
6. Manufacturer's recommended repair procedure for defects.
7. Manufacturer's head inversion tables for hot water cured CIPP.
8. Manufacturer's certification of corrosion resistance for the application.
9. Cure log for the complete installation, including tube diameter, thickness, resin, catalyst and curing time.

E. Contractor's Schedule.

F. Certification from the CIPP manufacturer indicating that the equipment to be used has been approved by the manufacturer for the use intended and the Contractor's personnel have been trained on the proper installation of the CIPP product.

G. Confined Space Entry per OSHA/MIOSHA requirements.

H. Traffic Control Plan.

1. All Traffic Control shall conform to the latest edition of the Michigan Manual of Uniform Traffic Control Devices (M.M.U.T.C.D.). Contractor shall prepare and submit a typical Traffic Control plan for review and approval.

I. Bypass Pumping Plan.

J. Design calculations for each sewer segment. Each sewer segment description shall include manhole numbers, a design summary showing key design parameters, assumptions, calculations, proposed design thickness, and shall be sealed by a professional engineer licensed in the State of Michigan.

K. One hard drive of the pre-lining CCTV videos, formatted for Windows Media Player, reports will be in a digital format (mdb). The video shall also display the pipe footage counter. Videos and reports shall also be submitted for viewing and reporting using WinCan Version 8 or other NASSCO approved software acceptable to the Owner. CCTV inspection and reports shall be PACP® coded.

1.07 CLOSEOUT SUBMITTALS

A. Contractor shall submit one (1) hard drive of the post-construction CCTV videos, formatted for Windows Media Player. Reports will be in a digital format (mdb). The video shall also display the pipe footage counter. Videos and reports shall also be submitted for viewing and reporting using WinCan Version 8 or other NASSCO approved software acceptable to the Owner. CCTV inspection and reports shall be PACP® coded.

1.08 SITE CONDITIONS

A. The Contractor shall familiarize themselves with the site and working conditions by making a personal examination of the site or sites and the surroundings in which work will be performed.

B. It is the responsibility of the Owner to locate and make accessible all manholes necessary for CIPP installation to occur.

PART 2 PRODUCTS

2.01 MATERIALS

A. The tube material shall meet the requirements of ASTM F1216-07(b), Section 5.1 for hot water cured CIPP

B. For UV light cured CIPP, the tube material shall meet the requirements of ASTM F 2019-03.

C. For hot water cured CIPP the resin material shall be a styrene-based, thermoset resin and catalyst system or an epoxy resin and hardener, meeting the requirements of ASTM F1216-07(b), Section 5.2.

D. For ultraviolet cured CIPP, the resin shall be a chemically resistant isophthalic polyester or vinyl ester thermoset resin and catalyst stem or an epoxy resin and hardener meeting the requirements of ASTM F 2019-03.

E. The minimum tube length shall be as required by the Contractor to span the distance between the access points.

F. The CIPP shall be fabricated from materials which, when cured, will be chemically resistant to withstand internal exposure to chemicals in accordance with ASTM F1216-07(b), Section X2.

G. A green dye, approved by the CIPP manufacturer, shall be added to the catalyst part of the resin to allow visual verification that the fabric tube has been thoroughly wetted-out by the Contractor.

2.02 DESIGN CRITERIA

A. The minimum CIPP thickness shall be determined based on a fully deteriorated condition of the host pipe, taking into consideration the other factors including the depth of bury of the sewer and groundwater conditions as indicated in PIPE SCHEDULE below of these specifications. The CIPP thickness shall also be sufficient to withstand the hydrostatic head used to install the liner so that no failures occur at service leads or other locations.

B. In no case shall the uncured tube be less than 6 mils thick.

C. If following installation, it is found that any portion of the CIPP does not meet the minimum design thickness as calculated by the Engineer, the Owner has the right to reject the entire segment. If the entire segment is rejected, the Contractor shall install a second CIPP of sufficient thickness to obtain the minimum design thickness at no cost to the Owner.

D. The design thickness for fully deteriorated gravity sewer shall be derived from equations X1.3 and X1.4 of the ASTM F1216-07(b) Specification.

E. The following design requirements listed in the table below along with the design information listed in PIPE SCHEDULE below of these specifications, shall be used to calculate the minimum CIPP design thickness**.**

Property	**Minimum Value**
Internal Flexural Modulus	350,000 p.s.i. (test method ASTM D790)
Long Term Flexural Modulus (50-year)	125,000 p.s.i. (test method ASTM D790)
Initial Flexural Strength	4,500 p.s.i. (test method ASTM D790)
Creep Retention Factor	50%
Ovality Reduction Factor	5%
Enhancement Factor	7
Safety Factor	2
Poisson's Ratio	0.3
Soil Density	130 lbs/cft
Soil Modulus	700 p.s.i. for pipe invert less than or equal to 15' deep
	1,000 p.s.i. for pipe inverts greater than 15' deep
Deterioration Rating	Fully Deteriorated
Depth of Sewer	As indicated elsewhere in the contract documents
Ground Water Height	Unless otherwise indicated, ½ the sewer depth
Surcharge Loading Beneath Any Street, Road, or Highway	HS-20 Highway
Surcharge Loading Beneath Any Railroad	E-80 Railroad
Minimum Service Life	50 years

F. The Contractor shall obtain the Engineer's acceptance of the minimum design thickness for each sewer segment prior to installation.

2.03 PIPE SCHEDULE

A. The following table lists the nominal pipe diameter, pipe length between manholes, and approximate sewer depth, which are to be the basis for minimum CIPP design thickness.

Manhole	Manhole	DIA (inch)	Length (feet)	Depth (feet)

PART 3 EXECUTION

3.01 PREPARATORY CLEANING AND PRE-LINING CCTV VIDEOTAPING OF SEWERS

A. The Contractor shall furnish all labor, electronic equipment and technicians to perform the closed-circuit television (CCTV) inspection of the sewers. All CCTV inspection shall be performed in accordance with NASSCO's PACP® standards. Technicians must be trained and certified in the use of NASSCO's Pipeline Assessment and Certification Program (PACP®).

B. The Contractor shall clean and televise, using a pan/tilt camera, all sewers proposed for lining prior to CIPP installation for submittal to the Owner.

C. The view seen by the television camera shall be transmitted to a monitor of not less than 17 inches. The monitor shall be located inside a mobile TV studio. The stationing of the television camera shall be continuously displayed on the television monitor while the sewer line is inspected. The Contractor's mobile studio shall be large enough to accommodate up to three (3) people for the purpose of viewing the monitor while the inspection is in progress. The Owner shall have access to view the television screen at all times.

D. CCTV inspection shall be performed by CCTV personnel who are trained and certified in the use of NASSCO's Pipeline Assessment and Certification Program (PACP®). Reports will be done in a digital format (mdb) compatible with WinCan8 or other NASSCO approve software acceptable to the Owner.

E. The camera shall be pulled through the pipe at a speed no greater than 30 ft./minute, unless approved by the Owner. The video shall also display the pipe footage counter.

F. The Contractor shall provide all equipment necessary for the proper cleaning, brushing, flushing, cutting service leads, root cutting, mineral deposit removal, and dewatering of the sewers prior to the lining operation.

G. The Contractor shall be responsible for all costs for water usage, including permits and providing meters and backflow prevention devices.

H. Necessary pulleys and supports shall be installed in manholes so as not to restrict the cleaning operation or damage existing manholes.

I. Any mechanical devices or otherwise which become lodged in the sewer shall be removed by the Contractor at the Contractor's expense.

J. Dewatering shall include necessary pumping equipment, plugs and temporary piping between manhole sections.

K. Cleaning of the sewer shall be carried out to the extent that the sewer section can be accurately inspected to evaluate and prepare the section for lining.

L. The sewer shall be thoroughly cleaned no more than 24 hours in advance such that only a light cleaning pass is necessary immediately prior to CIPP installation. This light cleaning pass will not be paid for separately but considered included in other work pay items.

M. High water pressure jetting shall not exceed 1,200 P.S.I.

N. The electricity for all operations will be furnished by the Contractor. If required to improve the quality of the television inspection, a ventilating system shall be furnished and installed between manhole sections.

O. The inspection reports and DVD videos shall become the property of the Owner.

P. The drilling procedures and equipment shall provide protection of workers particularly against electrical shock. As a minimum, grounding mats, grounded equipment, hot boots, hot gloves, safety glasses and hard hats shall be used by crewmembers.

Q. The drilling equipment shall be equipped with an operational alarm system capable of detecting electrical current.

R. The Contractor is responsible for protecting all existing utilities. The Contractor shall call Miss Dig (811) a minimum of 3 working days before any work is to begin. Existing utilities within the path of the proposed horizontal directional bore shall be "pot holed" to determine depth.

3.02 OWNER's REVIEW OF PRE-LINING CCTV VIDEOS

A. After the Contractor has performed preparatory cleaning and CCTV videotaping of the sewers to be lined, videos are to be submitted to the Owner for review as indicated under SUBMITTALS above. No sewers are to be lined until the Owner has authorized the Contractor to proceed with the CIPP installation.

3.03 CLEANING EQUIPMENT

A. Hydraulically Propelled Equipment.

1. The equipment used shall be of a moveable dam type and be constructed in such a way that a portion of the dam may be collapsed at any time during the cleaning operation to protect against flooding of the sewer. The moveable dam shall be equal in diameter to the pipe being cleaned and shall provide a flexible scraper around the outer periphery to insure removal of grease. If sewer cleaning balls or other equipment which cannot be collapsed is used, special precautions to prevent flooding of sewers and public or private property shall be taken.

B. High Velocity Jet (Hydro cleaning) Equipment.

1. All high-velocity sewer cleaning equipment shall be constructed for ease and safety of operation. The equipment shall have a section of two or more high-velocity nozzles. The nozzles shall be capable of producing a scouring action from 15 to 45 degrees in all size lines designated to be cleaned. Equipment shall also include a high-velocity gun for washing and scouring manhole walls and floor. The gun shall be capable of producing flows from a fine spray to a solid stream. The equipment shall carry its own water tank, auxiliary engines, pumps, and hydraulically driven hose reels. The NASSCO Jetter Code of Practice shall be consulted as a guide for the selection of different type nozzles and recommended pressure applications for various cleaning requirements.

3.04 ROOT REMOVAL

A. Roots shall be removed in the sections where root intrusions extend into the host pipe. Roots shall be removed to within ¼ inch of the host pipe. Special attention should be used during the cleaning operations to assure complete removal of roots from joints and service leads. Any roots which would prevent the installation of CIPP shall be removed. Procedures may include the use of mechanical equipment, rodding machines, bucket machines and winches using root cutters and porcupines, and equipment such as high-velocity jet cleaners.

3.05 MINERAL DEPOSIT REMOVAL

A. Mineral deposits shall be removed in the sections where mineral deposits extend into the host pipe. Mineral deposits shall be removed to within ¼ inch of the host pipe. Special attention should be used during the cleaning operations to assure complete removal of mineral deposits from joints and service leads. Any mineral deposits which would prevent the installation of the CIPP shall be removed. Procedures may include the use of mechanical equipment for the removal process.

3.06 PROTRUDING SERVICE LEADS

A. Existing service connections protruding ¼" or greater into the sewer shall be cut flush to the host pipe prior to the lining process by internal means only. Protruding taps shall be removed

by using the video assisted internal robotic cutting device. The use of flail reamers will not be allowed due to condition of the host pipe.

3.07 REMOVAL OF DEBRIS

A. The Contractor shall remove all debris between designated manholes by use of a vactor truck. In no instance shall debris be flushed to the adjoining sewer. If this occurs, Contractor will be responsible to clean this sewer segment at no additional cost to the Owner.

3.08 BYPASS PUMPING

A. The Contractor shall bypass all effluent around the section or sections of sewer to be lined.

B. Bypass pumping shall be by plugging into existing upstream manhole and pumping the effluent into a downstream manhole or separate system. The pump and bypass line shall be of adequate size to accommodate both normal and peak flow conditions.

3.09 TRAFFIC CONTROL

A. The Contractor shall erect and maintain traffic control devices in accordance with road right-of-way permits per the Michigan Manual of Uniform Traffic Control Devices (M.M.U.T.C.D.).

B. Dewatering of pits and excavations must meet the general provisions and specifications as set forth by the Owner's standards. The type of dewatering method used by the Contractor must be approved by the Owner, prior to commencing with the dewatering activity

3.10 CIPP INSTALLATION

A. Prior to installing the CIPP, the Contractor shall review the closed-circuit television inspection and reports and determine if the condition of the host pipe is acceptable to receive the CIPP installation.

B. CIPP installation shall be in full accordance with ASTM F1216-07(b), Section 7 for hot water cured CIPP or ASTM F 2019-03; Section 6 for UV light cured CIPP

C. The Contractor shall perform all operations in full accordance with all applicable OSHA/MIOSHA standards. Contractor shall have available on-site all safety apparatuses as required.

D. All wet-out or impregnation of the fabric tube must be performed in an EPA regulated, quality controlled facility. Resin saturation of the fabric tubes shall be 95% to 102% of optimum.

E. Hot water cured fabric tubes shall be stored under refrigeration.

F. UV light cured fabric tubes shall be shielded from light sources while in storage awaiting installation.

G. For UV light cured CIPP; a constant tension winch shall be used to pull the fabric tube into position within the host pipe. Winches shall be equipped with a device to limit winch tensions to 50% of the fabric tube's tensile strength.

H. For hot water cured CIPP; the Contractor shall raise the water temperature directly to the manufacturer's recommended curing temperature. The Contractor shall maintain this temperature until the fabric tube exotherms and causes a momentary spike in water temperature. The Contractor shall then allow the water to cool to 90 degrees Fahrenheit. At which time, the water circulation system may be shut off and the temperature monitored to ensure it does not increase; thereby assuring that the CIPP has fully cured.

I. The Contractor shall maintain a constant head pressure (water column) throughout the curing process and not exceed the pressures indicated on the Manufacturer's recommended head inversion tables.

J. The heat source for curing the CIPP shall be equipped with temperature monitors to gage the temperature of the incoming and outgoing water re-circulation system. Additional temperature monitors (thermocouples) shall be installed on the ends of the impregnated tube at the 6 o'clock position to ensure exothermic or cure of the resin occurs.

K. Pre-liners shall be installed, per the Manufacturer's recommendation, where the host pipe material is not compatible with the CIPP product.

L. It is the Contractor's responsibility to provide all field measurements such as length and size of each pipe segment to be lined and all service reconnection locations. The Contractor shall measure the internal circumference of the host pipe to determine the correct fabric tube diameter to be installed.

M. Reconnections of service connections shall be made per ASTM F1216-07(b), Section 7.9

N. Prior to any lining, the Contractor shall certify they have a minimum of two (2) complete working systems for reconnecting services. Contractor shall also certify that spare key components are on site before lining. Additional payment will not be made for excavating purposes to reopen service connections. Contractor will be responsible for all costs and liability associated with excavation and restoration work.

O. Prior to any sewer leads being completely opened to the newly lined sewer, a relief hole will be cut through the liner into each lead opening to relieve any water that has accumulated in the leads during the lining process. After the relief holes have been cut for each service, the process of completely opening each lead can proceed. Service leads shall be fully opened to pre-existing conditions for the full circumference of the service lead. Service connection cut-out or coupons shall be removed from the sewer system.

P. All service leads existing prior to CIPP installation shall be opened immediately following the lining process. Any damages occurring from services which are not re-opened shall be incurred solely by the Contractor.

Q. Upon successful completion of reconnecting service connections, the Contractor shall brush the full circumference of all service connections to eliminate rough or jagged edges of the liner.

R. If the liner fails to make a tight seal at the manhole wall, the Contractor shall apply a seal at that point. The seal shall be of a resin mixture compatible with the CIPP in accordance with ASTM F1216-07(b), Section 7.8.1.

S. Completed liner terminations shall be free of rough edges with a smooth transition to the manhole flow channel.

T. The Contractor shall terminate the CIPP at the manhole by trimming the inverted pipe end back within approximately two (2) inches of the outlet. Hydraulic cement should be used to finish the liner connections at both ends.

3.11 POST-CONSTRUCTION CCTV VIDEOTAPING OF FINAL PRODUCT

A. Upon successful installation of the CIPP pipe and reconnection of all service and branch connection, Contractor shall televise the final product for submittal to the Owner. The camera shall be pulled through the pipe at a speed no greater than 30 ft./minute, The video shall also display the pipe footage counter.

B. Post-construction videos shall be submitted to the Owner for review as indicated above under CLOSEOUT SUBMITTALS.

C. The circumference of all service connection cutouts shall be videotaped to show the entire perimeter of the cut out portion of the CIPP liner.

3.12 RESTORATION

A. Restoration of all disturbed areas will not be paid for separately but considered included for payment in other contract work pay items.

B. Any fences, landscape areas, rock gardens, irrigation systems, etc. disturbed by the Contractor in conjunction with any phase of CIPP installation shall be restored to equal or better condition by the Contractor.

3.13 QUALITY CONTROL

A. The Contractor shall supply the Owner with samples of each lining segment for testing.

1. Samples from sewers 12 inches in diameter and less shall be cut from a section of cured CIPP at an intermediate manhole or at a termination point that has been inverted through a like diameter pipe which has been held in place by a suitable heat sink such as sand bags.

2. For sewers 15 inches in diameter and larger, samples shall be fabricated from material taken from the tube and resin/catalyst system used and cured in a clamped mold and placed in the down tube to cure.

B. For sewers 12 inches in diameter and less, testing of the CIPP pipe will be in accordance with ASTM F1216-08 Section 8.1.1.

C. For sewers 15 inches in diameter and larger, testing will be in accordance with ASTM F1216-08 Section 8.1.2.

3.14 ACCEPTANCE

A. The completed liner shall be continuous between two access points. The liner shall be free of visual defects, damage, holes, delamination, uncured resin, and other defects.

B. There shall be no visible infiltration through or from behind the liner.

C. Contractor shall submit to the Owner one hard drive of DVD videos and reports. Videos shall be submitted as directed in 1.07 CLOSEOUT SUBMITTALS. A review of the submitted materials will be made to determine if the scope of work is complete and satisfactory.

END OF SECTION