**SECTION 0000**

**INSTALLATION OF CURED-IN-PLACE**

**STRUCTURAL LINERS**

**PART 1 GENERAL**

**1.01 SUMMARY**

The intent of this work is to provide for the reconstruction of manholes and other structures by the installation of a resin-impregnated flexible tube via a process commonly referred to as Cured-In-Place (CIP) or Cured-In-Place-Manhole (CIPM). This tube or material shall be inserted into the host structure and expanded to fit tightly against the walls, benches, and/or inverts or other surfaces of said structure(s) by the use of air pressure. The resin system shall then be cured by elevating the temperature of the air used for the inflation to a level sufficient for the initiators in the resin to effect a thermosetting reaction.

**1.02** **SCOPE OF WORK**

1. Preparation and Inspection – After cleaning and removal of debris, the structure shall be inspected by the Contractor to identify any leaks, active service laterals, or other pipes and appurtenances connected to the structure. The Contractor shall seal all leaks evident with a suitable chemical grouting material and plug or bypass other flows and pipes as necessary to begin the CIPM process.
2. Intent – The intent of CIPM lining is to restore the structural integrity of the host structure by providing a hot air cured material that laminates or bonds to the host structure’s wall(s). This liner is intended to be monolithic and adhere to the walls, benches, inverts, or other surfaces of the host structure as specified by the Engineer.
3. Bypass Pumping – The Contractor shall provide such piping, pumping, connections, fittings, and other appurtenances as necessary to bypass flows. There shall be no disruption of flow to the existing lines caused by the installation of this bypass, nor shall any sewer spills or overages be caused as a result of this action.
4. Reinstatement of Laterals and Connections – This work includes the reinstatement of all laterals and other connections that may be temporarily blocked as a result of the CIPM process. The Contractor shall use a mechanical cutter or other means as approved by the Engineer to place these connections back in service as soon as practicable after the curing process is complete.
5. Schedule of Work Hours – The Contractor shall work during the hours of 7:00 AM to 7:00 PM Monday through Friday. If there is a need for after-hours work or weekend work, prior consent shall be obtained from the Engineer.
6. Traffic Control – The Contractor shall be solely responsible for all signage, flagging, cones, personnel and any other item or personnel required for traffic control.

**1.03 RELATED SECTIONS**

**INSERT RELATED SECTIONS HERE OR DELETE**

**1.04 REFERENCES**

A. American Society for Testing and Materials (ASTM):

B. ASTM D638 Standard Test Method for Tensile Strength

C. ASTM D790-97 Standard Test Methods for Flexural Strength and Flexural Modulus

D. ASTM D-5813 Standard Specification for Cured-in-Place Thermosetting Resin Sewer Piping Systems

E. TABLE 1, Test Property Values:

ASTM-D-790

Flexural Strength 22,000 psi

Flexural Modulus 900,000 psi

ASTM-D-638

 Tensile Strength 12,000 psi

 Engineered Life Expectancy 100 Years

Installation Warranty 5 Years

Materials Warranty 10 Years.

**1.05** **PRE-QUALIFICATION AND APPROVAL**

A. Pre-Approval of Products - The system proposed (materials, methods, and workmanship) must be proven through previous successful installations to an extent and nature satisfactory to the Owner and the Engineer. Only previous installations that are commensurate with the size of the current project being proposed shall be considered for approval purposes. Since CIPM is intended to have a one hundred (100) year design life, only products deemed to have this performance shall be accepted. All products and installers must be pre-approved prior to the formal opening of bids/proposals

B. Criteria for Acceptance - Products and Installers seeking approval must meet *all* of the following criteria to be deemed commercially acceptable:

1. Certification - The Contractor shall supply engineering certification that the lining system design should provide a one hundred (100) year life service in a standard wastewater collection system environment.

2. Affidavit of Test Results - Contractor shall submit the Manufacturer’s affidavit, with the accompanying third party test data, showing that the product meets or exceeds the physical properties named herein on Table 1, Test Property Values, and that the CIPM liner material has passed a thirty (30) day chemical immersion test in twenty percent (20 %) sulfuric acid concentration with less than a twenty percent (20%) loss in flexural modulus.

3. Experience Documented - The Contractor shall submit Manufacturer’s experience qualification affidavit that the product proposed has been successfully used in wastewater structures for a minimum period of 10-years in wastewater collection systems, including 5 references where the product has been installed for a minimum of ten (10) years. Reference shall include the name and address of the client, date of installation, contact person, and phone number.

4. Alternate Product Data - Any alternative product being submitted for pre-approval must provide third party test certification that the product shall meet or exceed the physical properties named herein in Section 1.04.E, Table 1 Test Property Values. Proposed product and Contractor must also meet or exceed the installation standards, experience and performance qualifications as herein described in this specification. Spray and hand applied coatings shall not be considered for use on this project.

5. Warranty - Any product used must provide warranty that infiltration, further deterioration and root intrusion shall be prevented for the warranty period. Said warranty shall be non-prorated for a minimum ten (10) years on materials and five (5) years for labor.

6. Financial Means and Related Experience - For an Installer (a/k/a the Contractor) to be considered Commercially Proven, the Installer must satisfy all insurance, financial, and bonding requirements of the Owner, and must have at least three (3) year’s active experience in the commercial installation of the product bid.

7. Pre-Approval Deadline – To allow for adequate consideration by the Engineer and Owner, documentation for Products and Installers seeking pre-approved status must be submitted no less than seven (7) working days prior to the bid/proposal due date.

**1.06** **SUBMITTALS**

A. Safety Plan –The Contractor shall provide a confined space entry plan and identify designated safety supervisory personnel to the Engineer. The plan shall include confined space entry training certification of each employee assigned to the project.

B. Bypass Plan – The Contractor shall provide and otherwise develop a plan for bypass pumping. The pump and bypass lines shall be of adequate capacity and size to handle the anticipated flow. This plan shall be approved by the Engineer or Owner before work begins on the section(s) requiring bypass.

C. Other Submittal Information - The Contractor shall submit the following information to the Engineer prior to commencement of the work:

1. Literature - Manufacturer's product literature, application and installation requirements for materials used in liner.

2. Certification - Manufacturer's product certification for materials used in liner.

3. Samples of Miscellaneous Materials - A sample of public notices, door hangers, and other materials to be used by the Contractor for public communications purposes shall be provided to the Engineer or Owner.

4. Approvals - No liners shall be approved for installation until all items have been submitted, reviewed for conformance with the specifications and approved by the Engineer.

5. Shop Drawings - The Contractor shall submit for review, complete detailed shop drawings and schedule for all materials furnished under this section.

6. Compliance and Warranties - The Contractor shall submit for approval all manufacturer warranties for all materials furnished under this section and Manufacturer’s certification that the materials supplied are in compliance with this specification.

7. Training Certification - The Contractor shall submit for approval, the Manufacturer’s Licensee Certification that the Contractor is trained in the installation process and procedures for the proposed liner system under this section.

8. Reference List - The Contractor shall provide a reference list of not less than five (5) manhole rehabilitation projects, where the proposed product has been utilized and project completed in the past three (3) years that are similar in the size and scope of this project. Reference shall include: Name and address of the client, project name, contact person, phone number, scope including number of structures lined, and gross dollar amount of the project.

9. Written Warranties - The Contractor and Manufacturer shall warrant to the Owner in writing the installation, fabrics, and resins to be free of defects in workmanship and materials for a period of ten (10) years and certified Installer shall provide five (5) year labor warranty to repair or replace any failing conditions of the liner in the structure. Certification of the conforming warranty shall be provided prior to approval of the submittals and award of contract.

10. Field Experience -The Installer shall have a minimum of five (5) years of verifiable field experience.

**1.07** **QUALITY ASSURANCE**

A. Corrosion – The Contractor or Installer shall fabricate finished liner from materials which, when cured, shall be chemically resistant to internal exposure to domestic sewage.

B. Appearance – Liner(s) shall be continuous over the entire length of the insertion run and be as free as commercially practicable from visual defects such as foreign inclusions, dry spots, pinholes, winkles and delamination.

**PART 2 PRODUCTS**

**2.01** **ACCEPTED PRODUCTS**

A. Liner Performance Requirements - Liners shall be of the type that allows rehabilitation of a concentric, eccentric or flat top manhole without removing the manhole ring and top section or corbel.

B. Curing - The liner shall be installed and cured in place via controlled curing by heat and pressurization in the manhole to complete the curing process.

C. Monolithic Structure - The lining of the manhole or structure shall result in a monolithic structure bonded to the shape and contour of the existing manhole or structure. The liner shall be completely watertight, free of any pinholes or cracks.

D. Composite Materials System - CIPM Liner materials shall be no less than a three-layered composite system. Liner materials shall have a total pre-saturated fabric weight (i.e. weight before the application of epoxy resin) of forty-four (44) ounces, or fifty-six (56) ounces, or sixty-eight (68) ounces per square yard (see Test Property Values in Table 1 above).

1. Layer #1 shall be twelve (12) ounces, or eighteen (18) ounces, or twenty-four (24) ounces pre-saturated weight. This structural fiberglass material shall be with modified epoxy resins and bonded to the existing substructure.
2. Layer #2 shall be a gas and liquid impermeable membrane of special non-porous materials with felt embedded on both sides. This layer shall be bonded to Layer #1 and Layer #3. The weight of this layer shall be twenty (20) ounces. Layer #2 shall be imbedded between the structural layers #1 and #3 of epoxy-fiberglass to guard against nicks, tears, and damage to the gas impermeable membrane.
3. Layer #3 shall be twelve (12) ounces, or eighteen (18) ounces, or twenty-four (24) ounces pre-saturated weight. This structural fiberglass material shall be impregnated with modified epoxy resins and bonded to the existing substructure.
4. Layers #1 and #3 of a singular CIPM liner shall always have an equal pre-saturated weight.
5. Other material weights for Layers #1 and #3 may be designated by the Engineer if the parameters and conditions involving a particular structure or structures dictate usage of other weighted materials.
6. The Engineer shall designate the total pre-saturated weight of the composite material for each structure.

E. Inner Membrane - The CIPM liner shall be constructed such that the non-porous polyvinylchloride (PVC) inner membrane is protected from damage by the use of a structural fiberglass and epoxy layer on both sides. This inside surface protective layer is to protect the CIPM liner from impact damage, e.g. nicks from jet rodding machines and root cutters, hydro-vacuum nozzles, inspection cameras, survey equipment, and construction techniques used in pipeline rehabilitation. The non-porous PVC membrane shall not be exposed on the inside of the manhole. The importance of this protective layer cannot be overemphasized to protect the manhole from sulfides and other gases penetrating through nicks and cuts in an unprotected membrane. The CIPM liner must be impervious and without pinholes that shall allow hidden corrosion on the concrete behind the liner, which can cause the eventual failure of the liner and the manhole.

1. Certified Installers - The CIPM Lining System shall be applied by a Manufacturer certified licensed Installer and shall be installed in strict accordance with Manufacturer’s specifications. The Installer shall be trained in handling and application of the materials, and shall custom fit the liner to the manhole in order to protect the concrete and brick surfaces from sewer gases.
2. Approved Products - The CIPM Lining System shall be:
3. McNeil Technologies LLC Triplex 4400 Series, 5600 Series, 6800 Series, and/or other McNeil Technologies LLC Triplex Series as required and designated by the Engineer, or,

2. Approved equal.

2.02 **APPLICABLE MANUFACTURERS**

A. Standards - Products specified by named manufacturers are specified as a standard of quality.

1. McNeil Technologies LLC

2. Approved equal.

**2.03** **ACCEPTABLE LINER INSTALLERS**.

A. Acceptable Installers – Installers of specified manufacturers are specified as approved installers.

1. McNeil Technologies LLC

P. O. Box 1200

Destin, FL 32540

Phone: 850-687-9696

[www.triplexliner.com](http://www.triplexliner.com)

2. Approved Equal

**PART 3 EXECUTION**

**3.01** **STRUCTURAL INTEGRITY**

In general, the Owner assumes responsibility for the structural integrity of the rehabilitated structure. Prior to beginning work, the manhole shall be visually inspected by the Contractor and any areas of apparent structural damage shall be reported to the Owner for restoration.

**3.02** **STRUCTURAL PREPARATION**

A. Cleaning - Contractor shall perform preliminary cleaning of the structure with a high-pressure water jet blast at a minimum of thirty-five hundred (3,500) pounds per square inch (PSI) to prepare the structure for any necessary grouting or other preparation.

B. Manhole Steps - The Contractor shall remove the existing manhole steps. The metal portion of all steps shall be removed flush or to within ½” of the manhole interior wall surface. Any remaining holes shall be patched flush prior to applying the CIPM manhole rehabilitation system.

C. Removal of Deteriorated Material - Prior to patching severe defects in the manhole, all loose and deteriorated material shall be removed and disposed of by the contractor. The bench areas shall be repaired as required and contoured to promote hydraulic flow. The prepared surface of the shelves shall be smooth and shall be sloped to allow for all bench areas to drain to the pipe invert.

D. Patching - Manhole chimney, wall and shelf repair shall include plugging, and/or patching as necessary, with specified grout, plugging or patching compounds, hydraulic and/or Type II Portland cement or equal.

E. Leaks - All active hydrostatic water leakage shall be stopped within four (4) inches of where the liner shall end around pipes or the shelf area in accordance with the Manufacturer’s instruction. Minor active infiltration leaks and weeping may be stopped by the liner during the installation process.

F. Pipe Leakage – The Contractor shall plug the inlet pipe, inspect for infiltration leaks around the inlet and outlet pipes as well as in the invert channel. All leaks present shall be stopped by the use of chemical foam grout injection with Avanti 202 or equal and/or by the use of hydraulic cement. After stopping leaks with chemical grout, hydraulic cement shall be used to refinish the surface where the leak was occurring.

G. Cleaning Prior to Liner Installation - Prior to liner installation, the Manufacturer’s authorized Installer (i.e. the Contractor) shall clean all surfaces of the host structure with a high-pressure sprayer having an operating pressure of at least 3,500-PSI. After pressure cleaning, the Installer may clean the structure with a degreaser or other solvents as needed to remove any film or residue on the surface. The structure shall then be pressure rinsed with clean water.

H. Substrate - All cracked or disintegrated material shall be removed from the area to be patched exposing a sound substrate. Patches or filling of voids shall be allowed to cure according to the manufacturer’s specifications before continuing with the CIPM rehabilitation process.

I. Trimming Laterals – The Contractor shall remove any drop pipes to within two inches (2”) of the wall. All other incoming laterals shall be trimmed within two inches (2”) of the interior wall. The sewer main line inlet and outlet openings shall be properly trimmed within four inches (4”) of the wall in areas where such pipes protrude above the benches that form the invert channel. All incoming and outgoing lines shall be grouted with an approximate sixty degree (60º) taper with hydraulic cement, Portland type II cement, or a fifty/fifty (50/50) combination of hydraulic and Portland cements, forming a filet of not-less-than a six inch (6”) radius between the structure wall and each pipe. Such application of grout shall extend at least four inches (4”) from the outlet onto the wall area making a smooth transition for the liner connection to the pipe openings.

**3.04** **BYPASS PUMPING**

A. Contractor Responsibility - Unless otherwise specified the Contractor shall be fully responsible for bypassing existing flows in live sewers where existing force mains or other connections or construction shall be necessary to the existing system. If “live flow" mains have heavy flow conditions, the Contractor shall plan its work in order to maintain these flows and not interrupt service to the sewer systems’ users. This plan may include night work. The cost of any night work required shall be included in the contract price of the applicable item.

B. Approval of Bypass Plans Prior to Construction - The Contractor shall not perform any connection or construction to existing manholes until plans for bypassing have been submitted by the Contractor and accepted by the Owner or Engineer. Additionally, no plugging of existing city utility system gravity mains shall be made without the approval of the utilities department.

**3.05** **LINER INSTALLATION**

1. Scope - This work shall include the furnishing of all labor, materials, equipment, and testing for the rehabilitation of an existing brick or precast manhole by installing a cured-in-place laminated composite that is bonded to the host structure. The liner shall be comprised of a three-layered, structural system containing a non-porous membrane with felt imbedded on both sides, encapsulated between two structural layers of woven roving fiberglass; or pre-approved equal.
2. Custom Fabrication - Liner material and components shall have been custom fabricated to fit the specific configuration of each structure prior to the commencement of the liner installation. Liner material shall be of the type that allows rehabilitation of concentric, eccentric or flat top manholes without removing manhole ring, top section, flat-top, or corbel.
3. Monolithic Structure – The CIPM liner shall completely seal the manhole, shelf, pipe inlet and outlets, and the lid ring frame in a monolithic method, as required, or as shown on the plans. No holes, cracks or seams in the liner shall be left unsealed, as this would allow gases or fluids to flow behind the CIPM manhole liner.
4. Contractor Requirements – The Contractor shall furnish all labor, materials, equipment, and incidentals required to supply and install a chemical resistant CIPM Liner as required or as shown on the plans.
5. Protection of Host Structure - The CIPM Liner shall be designed and installed to protect concrete, brick and other manhole or other structure’s surfaces from corrosion. The CIPM liner product shall be designed to stop infiltration, root intrusion, and further deterioration in the structure. The interior surfaces to be protected shall include the walls, shelves, pipe junctions and the lid ring frame.
6. Omissions - Omission of a specific item or component obviously necessary for the proper installation and functioning of the system shall not relieve the Contractor from the responsibility of supplying that specific item or component at no additional expense to the Owner.

E. Air Pressure - The liner shall be applied under a responsible level of pressure.

**3.08** **OTHER CONSTRUCTION REQUIREMENTS**

1. Channel Reconstruction – The Contractor shall remove all loose grout and rubble from the existing channel. The Contractor shall rebuild the channel if required by shaping and repairing the slope of shelves or benches. Work shall include alignment of inflow and out flow ports in such a manner to prevent the deposition of solids at the transition point. All inverts shall follow the grades of the pipe entering the manhole. Changes in direction of the sewer and entering branch or branches shall have a true curve of as large a radius as the size of the manhole shall permit. Channels shall be shaped to allow entrance of maintenance equipment into pipes including buckets, CCTV cameras, etc.
2. Lining of Inverts - All inverts are to be lined unless otherwise indicated by the Engineer.
3. Overlap and Connections – The Manufacturer’s authorized licensed Installer shall install the CIPM liner with simultaneously combined air pressure and steam heat injection, except where jobsite conditions restrict use. Hand applied fiberglass and epoxy application shall not be accepted. The Installer shall line the manhole shelf/bench and invert channel areas with CIPM Liner System materials. These materials shall have been saturated with the epoxy resin and placed in the bottom to extend approximately three inches (3”) up the wall section, so as to overlap with the liner wall section. The CIPM Liner shall be made longer than the structure to overlap and reinforce the bench/floor transition area, providing overlap and double liner thickness in the critical corner section where the wall meets the bench.
4. Nighttime Installations - Night installations may be required in areas where heavy traffic conditions or where daytime heavy sewage flow levels exist.
5. Safety Rules - All safety rules, regulations, applicable laws and insurance requirements shall be observed in storing, handling, usage and application of the liner materials, resins and solvents (if any).
6. Confined Space Entry - A tripod and emergency retrieval system shall be used at all times for confined space entry.

**3.09** **QUALITY ASSURANCE AND TESTING**

A. Spark Testing - A complete structural liner spark test shall be conducted in accordance to ASTM D4787 and the instrument’s operating instruction manual. The following specific procedure(s) shall be followed:

1. Prior to lining, an initial spark test shall be conducted to establish conductivity of the structure and the test voltage. This shall be done by starting at the highest voltage of the meter and progressing downward to the lowest voltage that produces a good audible signal and spark. This voltage shall be the test voltage for testing the lining. The test shall be completed utilizing a silicone electrode attachment on the wand. This procedure is required in order to not damage the lining,

2. When the lining has been completed, the structure shall be tested to insure that no holidays or pin holes are present,

3. This test is to be used for CIPM, with documentation made to the Engineer that there are no holidays, etc.

4. A copy of the past instrument calibration certification must be included with the test logs.

B. Manufacturer’s Specifications - The installation of the approved liner system shall be in strict accordance with the Manufacturer’s written instructions. The Contractor may submit alternate thicknesses as per the Manufacturer’s recommendations as conditions dictate. The work shall include re-grouting all inlet and outlet lines and benches (if needed) including all preparation, installation, curing and finish operations for the complete rehabilitation process. The liner shall be installed and cured-in-place via a simultaneous pressurization blower system with steam heat injection, or other Manufacturer approved process. The curing process shall be typically completed in manholes in approximately four (4) hours.

C. Bonding - The CIPM lining of the structure shall result in a monolithic structure, bonded to the contours of the existing host structure. The liner shall be adequately bonded to the interior structure surface, and be completely water tight from the ring and cover area to the transition area where the shelf and invert channel connects. This bonding process shall all also include completely sealing the manhole wall and shelf areas to the inlet and outlet pipes.

D. Product Testing - Qualification testing of the CIPM liner materials shall have been completed prior to installation. The initial structural properties of the liner shall meet or exceed the properties shown in Table 1 referenced above.

E. Cleaned Structure--All surfaces of the host structure shall be clean to the concrete/brick substrate, and shall be acceptable to the Owner/Inspector and ready to receive the liner.

F. Resin Quantity--The liner Manufacturer shall provide a tag on each CIPM liner indicating the amount of catalyzed resin necessary for impregnation purposes in order to meet structural properties. This shall be acceptable with a tolerance variation of plus or minus five percent (± 5%).

**3.10 POST CONSTRUCTION ISSUES**

A. Elongation - The CIPM system shall be flexible, and have an elongation sufficient to bridge up to a one quarter inch (¼”) settling crack, without damage to the lining. The liner shall be able to bridge expansion cracks that may occur.

B. Post Installation Repairs - The CIPM system shall be repairable at any time during the life of the structure, with the same type of liner system materials used in the original installation, including repair or lining of the upper chimney portion where grade adjustments have been made. Repair lining materials shall be of the type that shall bond to the original liner materials.

**PART 4 DELIVERABLES AND PAYMENTS**

**4.01 MEASUREMENT**

1. Distance Measurement - Measurement of the actual number of vertical feet of CIPM installed shall be made from the invert of the pipe running through the host structure to the rim of the manhole or structure. Other structures receiving a CIPM liner will be paid for via a unit price or other unit of measure determined by the Engineer and provided for on the Bid Form.
2. Other Payment Units - Any ancillary items (if not deemed incidental to the project by the Engineer or Owner) shall be paid at a unit price basis as specified by the contract’s payment schedule.

**4.02 ACCEPTANCE**

1. Defective Work – Within sixty (60) days of the installation of the CIPM liner, the Engineer shall notify the Contractor of any defective work in writing. Defective work (if any) shall be corrected by the Contractor within sixty (60) days of receipt of this written notification.

**4.03 PAYMENTS**

1. Pay Estimates - Pay estimates shall be submitted on a regularly scheduled basis to the Engineer by the Contractor.
2. Payments - Payment for the rehabilitation of the structure(s) shall be made at a lump sum price and shall include all necessary labor, material and equipment to clean, seal off any water infiltration, prepare the walls, provide, install, and vacuum test the completed fiberglass liner.
3. Approval of Quantities - The Engineer shall review the quantities submitted by the Contractor, and shall immediately inform the Contractor of its certification or disallowance of any quantities submitted for payment. If the quantities of work in question by the Engineer can’t be immediately resolved to the satisfaction of both parties, the pay estimate shall move forward without those quantities included. Said denied quantities may be resolved and submitted on the next pay estimate.
4. Inspection - The completed installation shall be visually inspected to assure that dry spots are not present in the finished liner. This can also be accomplished by closed circuit television if visual inspection cannot be accomplished. No dry spots should be observed in the liner and no infiltration of groundwater should be observed coming through the liner or coming out at any place where the liner ends.

**END OFSECTION**

**RECOMMENDED PAYMENT SCHEDULE**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Item Number** | **Description** | **Est. Qty.** | **Unit** | **Unit****Price $** | **Total Price $** |
|  |  |  |  |  |  |
|  | GENERAL ITEMS |  |  |  |  |
|  | Mobilization | 1 | Lump Sum |  |  |
|  | Traffic Control | 1 | Lump Sum |  |  |
|  | Bypass Pumping | 1 | Lump Sum |  |  |
|  | CURED-IN-PLACE-LINER |  |  |  |  |
|  | CIPM Liner Installed | 000 | Vertical Foot |  |  |
|  | TOTAL BID |  |  |  | 0,000,000.00 |