

DATE: October 30, 2023

DEPARTMENT OF GENERAL SERVICES
BUREAU OF CAPITAL PROJECT DESIGN MANAGEMENT
1800 HERR STREET
HARRISBURG, PENNSYLVANIA

ADDENDUM NO. 2

on

PROJECT NO. DGS C-0251-0061 PHASE 001

PROJECT TITLE - PennDOT - Development of New Stockpile, Dauphin County

PROFESSIONAL:

Mimar McKissick Architects and Engineers, LLC
317 N Front St
Harrisburg, PA, 17101

If you submitted a bid prior to this Addendum being issued, your bid has been discarded and you must re-submit your bid(s) prior to the bid opening date and time.

SPECIFICATION CHANGES – ALL CONTRACTS

Item 2 - Specification Section 06 18 00 - Glued Laminated Construction: Edit Paragraph 2.7.A as follows:
"Manufacturer's standard seal coat or finish system."

Item 3 - Specification Section 06 18 00 - Glued Laminated Construction: As a clarification, glulam arch support anchor size and quantity to be coordinated with final loading from glulam supplier. Anchors to be L-bolts and plated anchor bolts.

Item 4 - Included in this Addendum is Specification Section 03 01 30 Spray In Place Pipe (SIPP) Lining.

DRAWING CHANGES – ALL CONTRACTS

Item 5 - Sheet E1.3: Electric hand dryer indicated on Plan Detail 2 shall be Xlerator Hand dryer by Excel. Model XL-BW, White Thermoset BMC Cover. Surface mounted in location as directed by Architect in field.

Item 6 - Sheet E1.3 Plan Detail 2: Add one (1) data jack and all associated wiring and accessories for complete installation in Open Area 01. Location as directed by Architect in field.

SECTION 33 01 30
SRAY IN PLACE PIPE (SIPP) LINING

PART 1 - GENERAL

1.1 STIPULATIONS

- A. The specifications sections “General Conditions of the Construction Contract”, “Special Conditions”, and “Division 1 - General Requirements” form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

- A. This section identifies the materials and robotic applications of a polymeric lining system for the rehabilitation of pressure and non- pressure pipes and conduits, potable water, sanitary and storm, intended to form Spray In Place Pipe (SIPP) system within the existing pipe to provide a structurally independent lining.

1.3 REFERENCES

- A. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
1. ASTM-C1557 Standard Test Method for Tensile Strength and Young’s Modulus of Fibers
 2. ASTM-D149 Standard Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies
 3. ASTM-D543 Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents
 4. ASTM-D570 Standard Test Method for Water Absorption of Plastics ASTM-D638 Standard Test Method for Tensile Properties of Plastics
 5. ASTM-D732 Standard Test Method for Shear Strength of Plastics by Punch Tool
ASTM-D790 Standard Test Method for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
 6. ASTM-D1599 Standard Test Method for Resistance to Short-Time Hydraulic Pressure of Plastic Pipe, Tubing, and Fittings
 7. ASTM-D2240 Standard Test Method for Rubber Property—Durometer Hardness
 8. ASTM-D2990 Standard Test Methods for Tensile, Compressive, and Flexural Creep and Creep-Rupture of Plastics

9. ASTM-D2992 Standard Practice for Obtaining Hydrostatic or Pressure Design Basis for “Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe and Fittings
10. ASTM-D4060 Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser
11. ASTM-D4541 Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
12. ASTM-D6289 Standard Test Method for Measuring Shrinkage from Mold Dimensions of Molded Thermosetting Plastics
13. ASTM F1216 Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube
14. ASTM-F2207 Standard Specification for Cured-in-Place Pipe Lining System for Rehabilitation of Metallic Gas Pipe
15. ASTM-G14 Standard Test Method for Impact Resistance of Pipeline Coatings (Falling Weight Test)

B. AMERICAN WATER WORKS ASSOCIATION (AWWA)

1. AWWA-C600 Installation of Ductile-Iron Mains and Their Appurtenances

1.4 SUBMITTALS

- A. Product Data: For each product specified. Include technical data and tested physical and performance properties.
- B. Engineering Design Calculations: The design for the lining shall be submitted to the Contract Administrator for approval 14 Days prior to installation. The design calculations shall show technical assumptions, identify the design formulas used and show the wall thickness and finished inside diameter. The design shall graphically illustrate the installation conditions, i.e., depth of pipeline, pipe invert and crown, and full details of the parameters used. The design work shall bear the seal and signature of installer's Registered Professional Engineer for review and approval.
- C. All calculations shall include data that conforms to the requirements of these specifications. Proposed manufacturer technology data, including third party test results for physical properties shall be submitted for all SIPP products and all associated technologies to be furnished.

PART 2 - PRODUCTS

2.01 Materials

- A. The SIPP System must meet the chemical resistance requirements of these contract documents. All materials shipped to the project site shall be accompanied by test reports certifying that the material conforms to the ASTM standards listed herein. Materials shall be shipped, stored, and handled in a manner consistent with written recommendations of the SIPP system manufacturer to avoid damage. Damage includes, but is not limited to, hydrating, freezing, spilling, mixing, contaminating of lining material, and cutting, fuzzing or ultra-violet (UV) degradation of carbon fiber filament. All damaged materials shall be promptly removed from the project site at the Contractor's expense and disposed of in accordance with all current applicable agency regulations.

2.02 Lining Materials

- A. The lining material shall consist of a thermosetting polymer, specifically designed for the use in pipeline applications.
- B. The two-component, thermosetting, corrosion resistant lining materials shall be solvent free. In addition, for potable water pipe systems, the lining materials shall be NSF/ANSI 61 certified for use in the appropriate pipe diameter and at the applied thickness, when used in accordance with curing and restoration requirements of the certification.
- C. The lining material shall have low viscosities that enable the pumping of the material components to a robotic application device.
- D. The lining material shall be able to generate a high-build, slump-resistant lining.
- E. The lining material must be able to be applied over a wide range of temperatures (32 °F to 120 °F).
- F. The lining material must be moisture tolerant to produce a hard, smooth lining with excellent water & chemical resistance and long-term durability. The lining material shall meet the chemical resistance requirements of ASTM F1216.
- G. The lining material shall be able to achieve required lining thickness while completely encapsulating all pipe welds, rivets, joints and edges.
- H. The lining material shall have an initial rapid cure time (gel time) or thixotropic nature necessary to prevent sagging, dripping, or puddling of the lining material.
- I. At 75 °F, the cure time of the lining material to be tack free shall not exceed 10 minutes, and normal immersion use shall not exceed 24 hours.

- J. No primers are required for the lining material to achieve proper performance.
- K. The lining material shall contain no volatile organic compounds (VOC) or solvents.
- L. Laboratory testing report in accordance with ASTM or AWWA procedures as cited.
- M. All lining materials within the lining system shall be produced and supplied by the same manufacturer.
- N. When applied, the material shall produce a continuous, cured, smooth lining of consistent thickness, absent of serious lining faults.
- O. The lining material shall have a minimum unopened shelf life of six months.
- P. The lining shall have fluid resistance/permeability and long-term durability for a minimum 50-year design life.
- Q. The two components shall be supplied in two distinct colors, when mixed together in the proper ratio, the mixed material shall produce a third distinct color.

2.03 Reinforcement Filaments

- A. Reinforcement filaments are added in the lining structure to significantly increase the strength of the lining. The filament shall possess high tensile strength, modulus, long continuous length. The reinforcement filaments shall be chemically inert.
- B. The reinforcement filaments, normally carbon fiber, shall have uniform thickness, high strength and modulus that meet the requirements of these contract documents.
- C. The filaments shall be uniformly impregnated with UV initiated resin and wound on spools for storage before the lining application.
- D. The fiber shall be properly stored to avoid UV light activation of resin.

2.04 Manufactures

- A. VersaFlex
- B. Elite Pipeline Services
- C. Spray In Place Solutions

- D. Or equal as approved by the professional.

2.05 Structural Requirements

- A. The physical properties and characteristics of the finished SIPP will vary considerably, depending on the types and mixing proportions of the materials used and the degree of cure executed. It shall be the responsibility of the Contractor to control these variables and to provide a SIPP system which meets or exceeds the minimum properties specified herein.
- B. The SIPP shall be designed as per the appendixes of ASTM F1216 The SIPP system design shall assume no bonding to the original pipe wall.
- C. The design engineer shall set the long-term (50 year extrapolated) Creep Retention Factor at a default of 50% of the initial design flexural modulus as determined by ASTM D790 test method. This value shall be used unless the Contractor submits long-term test data (ASTM D2990) to substantiate a different retention factor.
- D. The cured pipe material (SIPP) shall, at a minimum, meet or exceed the structural properties, as listed below.

2.06 Minimum physical properties

- A. The physical properties of SIPP lining material are variant depending on the polymeric type (epoxy, polyurea, polyurethane, hybrid) and their formulation (additives, etc.). The manufacturer shall provide all the testing data of the material properties of polymeric materials, fiber or fabric as required by TABLE 1 to TABLE 4, as part of material submittals.
- B. Closed cell porous elastomeric material shall comply with the properties and requirements in TABLE 1.

TABLE 1 Initial Properties-Closed Cell Porous Elastomer Polymeric Materials

Short Term Property ^A	Test Method	Minimum Value	
		psi	(MPa)
Tensile modulus	D638	400	(2.76)
Tensile strength	D638	300	(2.07)
Adhesion	D4541	300	(2.07)
Elongation	D638	400%	

Dielectric Strength	D149	250V/mil
Long Term Property ^B		
50 years design life retention of modulus and mechanical properties	D2990	50%

^A The minimum values as certified by the manufacturer to the user for field sample testing in Table 1.

^B The user should require the manufacturer to provide test results per Test Method D2990 to verify long-term structural properties.

- C. Reinforcement filament material shall comply with the properties and requirements in TABLE

TABLE 2 Initial Properties-Filament Reinforcement Materials

Property	Test Method	Minimum Value	
		psi	(MPa)
Tensile modulus	C1557	30 000 000	(206 843)
Tensile strength	C1557	500 000	(3 447)
Elongation	C1557	1.5%	

- D. Rigid polymeric materials shall comply with the properties and requirements in TABLE 3.

TABLE 3 Initial Properties-Rigid Polymeric Materials

Short Term Property ^A	Test Method	Minimum Value	
		psi	(MPa)
Flexural modulus	D790	350 000	(2 413)
Flexural strength	D790	9 000	(62)
Tensile modulus	D638	350 000	(2 413)
Tensile strength	D638	7 000	(48)
Shear Strength	D732	5 000	(34)
Adhesion (steel) ^B	D4541	800	(5.5)
Elongation	D638	3%	
Hardness- Shore D	D2240	75	

Dielectric strength	D149	250V/mil
Impact Resistance	G14	75 in-lbs
Long Term Property ^C		
100 years design life retention of modulus and mechanical properties	D2990	50%
Short Term Property ^A		Maximum Value
Abrasion resistance ^D	D4060	100 mg loss
Water absorption	D570	2%
Thermosetting shrinkage	D6289	2%
Chemical resistance ^E	D543 & F2207	pass

^A The minimum values as certified by the manufacturer to the user for field sample testing in Table 3.

^B Concrete-300 psi or substrate failure.

^C The user should require the manufacturer to provide test results per Test Method D2990 to verify long-term structural properties.

^D C17 wheel - 1,000 g/1000 cycles.

^E The user should require the manufacturer to provide test results per Test Method D543 and F2207 to verify chemical resistance properties.

- E. Burst pressure test shall comply with the properties and requirements in TABLE 4.

TABLE 4 Lining Bursting Tests

Property ^A	Test Method	Minimum Value
Short-Time Hydraulic Pressure of Lining System	D1599	2 × MAOP
Long-term Hydrostatic Pressure of Lining System	D2992	2 × MAOP

^A The hydraulic testing results for large diameter lining system can be obtained from modified D1599 and D2992 tests or extrapolated from the test results of small diameter lining systems.

- F. The required structural SIPP wall thickness shall be based, as a minimum, on the physical properties of the cured composite and in accordance with the Design Equations contained in the appendix of ASTM F1216 and the following design parameters:

TABLE 5 Lining Design Parameters

Design Safety Factor	2.0 (1.5 for pipes 36" or larger, if applicable)
Creep Retention Factor	50%
Ovality	2% or as measured by field inspection
Constrained Soil Modulus	Per AASHTO LRFD Section 12 and AWWA Manual M45
Groundwater Depth	As specified or indicated on the Plans
Soil Depth (above the crown)	As specified or indicated on the Plans
Live Load	Highway, railroad or airport as applicable
Soil Load (assumed)	120 lb./cu. ft.
Minimum Service Life	50 years

- G. The Contractor shall submit, prior to installation of the lining materials, certification of compliance with these specifications. Certified material test results shall be included that confirm that all materials conform to these specifications and/or the pre-approved system. Materials not complying with these requirements will be rejected.

2.07 Lining Equipment

- A. All the lining equipment planned to be used during the lining process shall be identified and explained in detail in the Performance Work Statement (PWS) submitted by the contractor. The lining equipment shall not be used in lining process until approved by the Client Agency.
- B. Lining equipment used to apply the lining material shall be suitable for the intended work and meet the requirements of the lining material manufacturer.
- C. Lining equipment used for application of lining shall be suitable to store, heat, move, and mix the lining material and function in accordance with the lining manufacturer's instructions for use.
- D. Lining Equipment shall be capable of providing necessary heat, flow and pressure required for lining installation conditions.
- E. Lining equipment heat sources shall be equipped with suitable monitors to gauge temperatures of lining material components.
- F. Lining equipment used to pressurize and pump the lining material shall be equipped with flow meters and pressure gauges capable of monitoring the individual components of lining material to ensure material mixing within manufacturer's recommended tolerances for the specified mixing

ratio. The mixing ratio shall meet the requirements from the lining material manufacturer.

- G. Lining equipment flow meters and pressure monitors shall provide a continuous record of the information: Volume and flow of material to the material casting assembly, Pressure in all component hoses.
- H. Lining equipment shall be capable of autonomous axial centering of the material casting assembly (application head, spinner, spinner cone, etc.) during all lining processes to assure uniform lining material dispersion and lining thickness.
- I. Lining or ancillary equipment shall be capable of filling or applying thin adhesive membrane over all cracks, perforations and other discontinuities in the pipe prior to lining.
- J. Lining equipment shall be capable of applying low Poisson's ratio closed cell elastomer as the initial bonding layer and a high tensile rigid layer to form the composite lining.
- K. Lining equipment shall be capable of incorporating a reinforcing filament or fabric into the composite lining concurrently with the rigid lining installation process. Lining equipment shall incorporate helically and axially or both oriented reinforcing filaments into or onto the lining material concurrently with the lining installation process.
- L. Lining equipment (umbilical and casting assembly) shall be capable of self- propulsion.
- M. Lining equipment shall be equipped with an umbilical for the conveyance of fluids or communications or electrical power or combinations thereof between lining rig and lining device to be fully autonomous. Umbilical or tether equipment shall be capable of self-propulsion.
- N. Lining equipment shall be capable of applying highly accurate and consistent material dispersion in any diameter of pipe.
- O. Lining equipment shall be capable of real time lining thickness measurement at no less than four (4) points circumferentially on the lining surface with no less than 85 degrees separating any measurement point. Lining equipment shall consist of a real-time lining material thickness measurement and verification system.
- P. Lining equipment shall be capable of traversing and lining through short radius ninety-degree (90°) pipe bends or mitered bends for the pipe diameter being lined.
- Q. Lining or ancillary equipment shall be capable of autonomously cleaning and sanitizing umbilical's/tethers prior to entry into the pipe for potable water applications.
- R. Lining equipment shall be capable of real time, onboard video monitoring and recording of the lining process.
- S. Lining equipment shall be capable of recording all lining video with time/date stamp. Lining

equipment shall also be capable of reporting and documenting lining location, thickness and lining material processing data during lining operation.

PART 3 - EXECUTION

3.01 SAFETY

- A. The Contractor shall conform to all work safety requirements of pertinent regulatory agencies, and shall secure the site for the working conditions in compliance with the same. The Contractor shall erect such signs and other devices as are necessary for the safety of the work site.
- B. The Contractor shall perform all of the Work in accordance with all applicable OSHA standards. Emphasis shall be placed upon the requirements for entering confined spaces and with the equipment being utilized for pipe renewal.
- C. The Contractor shall submit a proposed Safety Plan to the Client Agency, prior to beginning any work, identifying all competent persons. The plan shall include a description of a daily safety program for the job site and all emergency procedures to be implemented in the event of a safety incident. All work shall be conducted in accordance with the Contractor's submitted Safety Plan.
- D. Compensation for all work required for the submittal of the Safety Plan shall be included in the various pipelining items contained in the Proposal.

3.02 Quality Control

- A. A detailed quality control plan (QCP) shall be submitted to the Client Agency that fully represents and conforms to the requirements of these specifications. At a minimum the QCP shall include the following:
 - B. A detailed discussion of the proposed quality controls to be performed by the Contractor.
 - C. Defined responsibilities, of the Contractor's personnel, for assuring that all quality requirements for this contract are met. These shall be assigned, by the Contractor, to specific personnel who is approved by the lining material manufacturer.
 - D. Proposed procedures for quality control, product sampling and testing shall be defined and submitted as part of the plan.
 - E. Proposed methods for product performance controls, including method of and frequency of product sampling and testing both in raw material form and cured product form.
 - F. Scheduled performance and product test result reviews between the Contractor and the Client Agency at a regularly scheduled job meeting.

- G. Inspection forms and guidelines for quality control inspections shall be prepared in accordance with the standards specified in this contract and submitted with the QCP.
- H. Proposed procedures for quality control, product sampling and testing shall be defined and submitted as part of the plan.
- I. Proposed methods for product performance controls, including method of and frequency of product sampling and testing both in raw material form and cured product form.
- J. Scheduled performance and product test result reviews between the Contractor and the Client Agency at a regularly scheduled job meeting.
- K. Inspection forms and guidelines for quality control inspections shall be prepared in accordance with the standards specified in this contract and submitted with the QCP.
- L. Two (2) days of inspector training, by the SIPP system manufacture, for the Client Agency's inspectors shall be provided. This training shall be prior to lining installation, include both technical and field training and include all key aspects of visual inspection and sampling procedures for testing requirements. On smaller projects having an estimated duration of less than two (2) weeks of installation work, the system manufacturer shall furnish a check list containing key elements of the SIPP installation criteria that are important for the Owner's inspector to ensure that quality control and testing requirements are performed in accordance with the contract documents.
- M. Contractor shall provide a NACE and/or SSPC and/or manufacturer approved lining inspector for QA/QC to be reviewed and approved by the Client Agency. The QA/QC Lining Inspector will verify the overall lining was performed in the field per the requirements of this specification.
- N. The QA/QC Lining Inspector shall review and certify that all tests results specified in the contract document are met. Contractor shall repair any damaged lining per manufacturer's repair procedures that result from the QA/QC testing at no additional cost to the Client Agency.
- O. All pipe cleaning, surface preparation, and lining activities shall be inspected by the QA/QC Lining Inspector and approved by the Client Agency. The contractor shall also notify the Client Agency sufficiently in advance so as to be present during the following activities to witness the operations on site: The completion of pipe cleaning, The completion of surface preparation, Lining thickness measurements, During any lining repair.
- P. The QA/QC Lining Inspector shall perform visual, CCTV inspections and dry lining thickness measurements after lining process. The QA/QC Lining Inspector shall submit daily reports to the Client Agency for records. Reports shall include the following information as included but not limited to: CCTV color recording of the pipe line after cleaning prior to the lining process. Environmental conditions prior to lining application, including surface temperature, ambient air temperature, relative humidity and dew point, Observations of pipe cleaning and surface

preparation, Temperature and Flow (GPM) of lining material during lining operations, Lining thickness measurements.

- Q. Contractor shall touch up any areas, where QA/QC lining inspection was performed, to the satisfaction of the QA/QC Lining Inspector.
- R. Contractor shall prepare samples of the lining in a manner consistent with the application technique being used. The curing of samples shall be done in a like environment in which the pipe lining will be cured. The samples for bond strength, mechanical properties, porosity (holidays) and lining thickness shall be tested by USA accredited, independent laboratory. The test results will be reviewed and approved by the Client Agency.

3.03 ON-SITE ACTIVITIES

- A. Preparation, cleaning, inspection, flow bypassing and public notification. The Contractor shall clean the interior of the existing host pipe prior to installation of the lining. All debris and obstructions that will affect the installation and the final SIPP product delivery to the Client Agency shall be removed and disposed.
- B. The lining shall be constructed of materials and methods that, when installed, shall provide a jointless and continuous structurally sound SIPP to withstand all imposed static, and dynamic loads on a long-term basis.
- C. The Contractor may, utilize any of the existing manholes in the project area as installation access points.
- D. Cleaning of Pipe Lines – Before ordering lining materials for the project, the Contractor shall remove all internal debris from the pipe line that will interfere with the installation and the final product delivery of the SIPP, as required in these specifications, and accurately measure and document the exact size of the existing pipeline to be rehabilitated. Solid debris and deposits shall be removed from the system and disposed of properly by the Contractor. Moving material from manhole section to manhole section shall not be allowed. As applicable, the contractor shall either plug or install a flow bypass pumping system to properly clean the pipelines. Precaution shall be taken by the Contractor in the use of cleaning equipment to avoid damage to the existing pipe. The repair of any damage, caused by the cleaning equipment, shall be the responsibility of the Contractor. Unless otherwise specified by the Client Agency, the Contractor shall dispose of all debris at no charge.
- E. Bypassing Existing Flows - The Contractor shall provide for the flow of existing mainline and service connection effluent around the section or sections of pipe designated for SIPP installation. Installation of the lining shall not begin until the Contractor has installed the required plugs or a sewage bypass system and all pumping facilities have been installed and tested under full operating conditions including the bypass of mainline and side sewer flows. Once the installation has begun, existing flows shall be maintained, until the lining composite is

fully cured and televised. The pump and bypass lines shall be of adequate capacity and size to handle peak flows. The Contractor shall submit a detail of the bypass plan and design to the Client Agency before proceeding with any SIPP installation.

- F. Contractor shall perform post-cleaning video inspections of the pipelines. Only PACP certified personnel trained in locating breaks, obstacles and service connections by closed circuit television shall perform the inspection. The Contractor shall provide the Client Agency a copy of the post-cleaning video and suitable log, and/or in digital format, for review prior to installation of the SIPP and for later reference by the Client Agency.
- G. Line Obstructions - It shall be the responsibility of the Contractor to clear the line of obstructions that will interfere with the installation and long-term performance of the SIPP.
- H. The Contractor shall be responsible for confirming the locations of all branch service connections prior to installing the SIPP. Typically, only service connections deemed “active” shall be reopened by the Contractor.
- I. The Contractor shall be allowed use water from an Client Agency-approved fire hydrant in the project vicinity. Use of an approved double check backflow assembly shall be required. Contractor shall provide his own approved assembly. Contractor shall pay current market price for all water usage.

3.10 DELIVERY, STORAGE AND HANDLING OF LINING MATERIAL

- A. The lining material shall be delivered to the project site in unopened, sealed containers and labeled with the manufacturer’s identification and printed instructions for use.
- B. Care shall be taken during transportation, handling, and installation of lining material and safety procedures shall be maintained in accordance with SDS.
- C. Lining material shall be stored in original sealed containers in a dry environment at a temperature specified by the material manufacturer.

3.11 PIPE CLEANING

- A. The lining applicator shall perform a mechanical cleaning with a device specifically manufactured for the purpose of cleaning the pipe of the same diameter of the pipe to be lined to the requirements of the lining system to be applied. This includes the removal of corrosion by products; chemicals or other deposits; loose or deteriorated remains of old lining material; and oils, grease, and accumulations of water, dirt, and debris.
- B. Several lining techniques are available for removing corrosion, debris and encrustation and preparing the existing pipe: Power Boring, Drag Scraping, Air Scouring, High Pressure Water Jetting, Abrasive Pigging, Sponge Blasting, Venturi Media Blasting.

3.12 PRE-LINING PREPERATION

- A. The lining applicator shall inspect the cleaned pipe throughout the length to be lined with CCTV system. In portable water applications, the lining applicator shall disinfect all parts of the equipment before insertion into the water mains. The CCTV system camera shall be specifically designed and constructed for pipe inspection. The camera should provide the

flexibility in examining pipe details, especially joints and service connections extending into the pipe. The lighting system shall be capable of lighting the full periphery of the pipe. The camera shall provide a color picture.

- B. The interior surfaces of the pipe shall be clean and with any water leaks stopped to a drip-tight condition before the lining material is applied. Service connections shall be carefully inspected to ensure that there is no debris blocking any service taps and there is no inflow of water into the pipe. If any services are leaking, appropriate steps shall be taken to stop the leak to a drip-tight condition. The method to be used shall be reviewed and approved by the client agency or his representative. A video recording shall be made of the entire inspection and submitted to the Client Agency for review and approved by the Client Agency or his representative prior to lining. If the initial video inspection reveals significant issues and resolution is not clear, the CCTV inspection may be repeated.

3.13 INSTALLATION OF LINING

- A. The contractor shall follow the manufacturer recommendations on dehumidifying or heating the pipe, or both. The manufacturer's recommendations for both minimum and maximum temperatures of lining materials, and ambient air temperature and surface temperature for applying the lining material shall be followed.
- B. Before the lining material is applied, the contractor shall demonstrate that the equipment is functioning properly by circulation of the lining material components in the equipment. Temperature of the components and mixing ratio of the pumped lining material shall be verified (by weight or volume) to be within the manufacturer's tolerances. After pulling the umbilical through the length of pipe to be lined and attaching the lining head, the contractor shall "spin-up" the lining head to its operating rotation speed and sample the mixed lining material with the uniform color expected of thoroughly mixed components. Material dispersed from the lining apparatus during the demonstration shall not be applied to the pipe wall. Instead, a sacrificial surface shall be placed within the pipe which shall receive any material dispersed from the lining apparatus during the demonstration. After inspection, this sacrificial surface shall be removed from the pipe.
- C. Once pipe temperature has been checked, the lining rig is correctly heated, fully prepared and checked for operation, the lining material is at the correct temperature and any dehumidification equipment recommended by the manufacturer to facilitate the application has been put in place, lining can begin.

- D. The lining shall be applied in single or multiple passes using either an autonomous application device or an application device connected to a lining rig through an umbilical or tether. It shall be the lining manufacturer's responsibility to establish limitations, reviewed and approved by the Client Agency on each lining application, including thickness of application per pass, lining material curing time, and instructions or limitations for multiple-layer lining and any re-linings.
- E. The rigid lining material shall not bond directly to the host pipe. A low Poisson's ratio, closed cell porous materials shall be applied to the host pipe as the initial bonding layer of the composite lining system. Field samples shall be tested by USA accredited laboratory for tensile adhesion to the pipe wall in accordance with Test Method D4541. For the composite laminate lining, field samples of the inter-coat bonding between the elastomer layer and the rigid layer shall be also tested for tensile adhesion in accordance with Test Method D4541.
- F. Reinforcement filaments shall be wound in a unidirectional or bi-directional helical orientation onto the initial bonding layer (elastomer layer) before applying the rigid layer of the composite. The filament shall be bonded to the elastomer layer and the rigid lining material shall be immediately applied over the elastomeric layer to encapsulate the filaments. The cured rigid lining material shall bond to the elastomer layer and filament layers to create the finished composite laminate lining system.
- G. Once lining operations commences, the contractor shall operate the lining apparatus continuously in each run by using the computer-controlled accumulator reel on the synchronized lining rig and self-propulsion devices, such as tracks, wheels or belts on both the umbilical and lining device to propel the lining device through the pipe. Any maintenance stoppages shall not exceed the recoat time published by the lining manufacturer. This requirement may be modified if the contractor submits methods and details to prevent "cold joints" and ensure that the lining is continuous at all locations to the Client Agency for review and approval.
- H. The lining system manufacturer's instructions shall be followed to ensure the lining device and umbilical traverse in a synchronized fluid motion during the entire application process.
- I. The lining applicator shall use the thickness measurement functionality of the lining equipment to measure and record the real-time lining thickness throughout the entire lining process.
- J. The lining applicator shall monitor the lining device throughout the lining process via on-board cameras. On-board cameras shall be utilized to monitor all material casting assembly (application head, spinner, spinner cone) and filament winder functionalities. If a serious fault is suspected, the lining process shall immediately cease.
- K. Once the lining is completed, a dip card or test spool shall be used to sample resin cure and shall be kept by the contractor as a permanent record. Immediately after lining, the contractor will review the lining printout in accordance with the manufacturer's procedures and provide a copy to the Client Agency's representative. The cure period shall commence

only when the lining device has been removed out of the pipe completely.

- L. If difficulties with the lining operation are encountered or there is a notable change in the rate of progress, the Client Agency shall be contacted immediately. Within twenty-four hours of the difficulty, the contractor shall provide a written report to the Client Agency describing the details of the difficulty and the actions that were taken or are proposed to be taken to deal with the difficulty. Where lining operations may cease due to the malfunction of the lining apparatus, the contractor shall be prepared to prevent discontinuities in the lining or the formation of "cold joints" by having sufficient spare parts or a second lining apparatus at the project site to continue lining operations without a delay lasting beyond recoat time published by the lining manufacturer.
- M. The contractor shall receive no additional compensation for any expenses resulting from the failure of the lining device or ancillary equipment to apply the lining material due to the malfunction of the lining apparatus. Contractor shall take every precaution to prevent a delay lasting beyond the recoat time published by the lining manufacturer.
- N. Should a "cold joint" form or the lining not be continuous at any point during lining operations, the contractor shall repair the defect following recommendations from the lining material manufacturer. Manufacturer guidelines must prescribe all additional lining preparation necessary if a repair is required and another material coat is to be applied after the lining materials recoat window has been exceeded. The Contractor shall receive no additional ion for the preparation of "cold joints".

3.14 POST-LINING INSPECTION

- A. Remove Upon completion of lining operations and initial curing, a visual inspection at the entrance and exit points of the lined pipe shall be undertaken by the Client Agency or Client Agency's representative to verify that the lining is cured in accordance with the manufacturer's recommendations or requirements, or both and there is no evidence of uncured product.
- B. The contractor shall inspect the lined pipe throughout the entire length with CCTV equipment after the lining material has cured. The contractor shall limit bacteriological contamination from the CCTV equipment. The interior surfaces of the pipe must be completely covered by the lining material without evidence of poor mixing or excessive ringing. Attention must be paid to inspect the service connections to ensure that there is no evidence of blockage. A video recording shall be made of the entire inspection and turned over to the Client Agency at the end of the project.
- C. The travel speed of the camera shall allow the survey to be carried out effectively along the circumference and length of the lined pipe.
- D. The unit price bid per linear foot of pipe line pre-lining inspection shall include all of the Contractor's costs of whatsoever nature. The price bid shall include: furnishing and setting up of all equipment, labor, and materials necessary to clean and perform

inspection of the pipeline, including an explosion-proof television camera, as necessary; recording all information on USB Plug and Play device (flash drive or hard drive) for review by Client Agency; submittal of video in MP4 format and logs in pdf format, both of which must be submitted in accordance to the naming convention required within the applicable details, identifying and reporting structurally deficient pipe sections.

3.15 CLEANUP

- A. The Contractor shall reinstate all project areas affected by their operations to an equal or better than existing condition upon completion of the SIPP installation. Re-grading of rutted areas and re-seeding of disturbed areas is required.
- B. Clean up debris and unused material, and remove from the site. Dispose of all material in accordance with local, state, and federal regulations. Do not dump material in manholes or inlets.

END OF SECTION