PERFORMANCE SPECIFICATION GUIDELINE

FOR THE INSTALLATION OF

CURED-IN-PLACE PIPE (CIPP)

2nd Edition June 2011

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PART 1.0 GENERAL

1.0.1 These PSG's include the minimum requirements for the rehabilitation of sanitary sewer pipelines by the installation of Cured-In-Place Pipe (CIPP) within the existing, deteriorated pipe as shown on the plans included as part of these contract documents.

1.0.2 The rehabilitation of pipelines shall be done by the installation of a resin-impregnated flexible tube which, when cured, shall be continuous and tight-fitting throughout the entire length of the original pipe. The CIPP shall extend the full length of the original pipe and provide a structurally sound, joint-less and water-tight new pipe within a pipe. The Contractor is responsible for proper, accurate and complete installation of the CIPP using the system selected by the Contractor.

1.0.3 Neither the CIPP system, nor its installation, shall cause adverse effects to any of the Owner's processes or facilities. The use of the product shall not result in the formation or production of any detrimental compounds or by-products at the wastewater treatment plant. The Contractor shall notify the Owner and identify any by-products produced as a result of the installation operations, test and monitor the levels, and comply with any and all local waste discharge requirements. The Contractor shall cleanup, restore existing surface conditions and structures, and repair any of the CIPP system determined to be defective. The Contractor shall conduct installation operations and schedule cleanup in a manner to cause the least possible obstruction and inconvenience to traffic, pedestrians, businesses, and property owners or tenants.

1.0.4 The prices submitted by the Contractor, shall include all costs of permits, labor, equipment and materials for the various bid items necessary for furnishing and installing, complete in place, CIPP in accordance with these specifications. All items of work not specifically mentioned herein which are required, by the contractor, to make the product perform as intended and deliver the final product as specified herein shall be included in the respective lump sum and unit prices bid.

1.1 DESCRIPTION OF WORK AND PRODUCT DELIVERY

1.1.1 These PSG's cover all work necessary to furnish and install, the (CIPP). The Contractor shall provide all materials, labor, equipment, and services necessary for traffic control, bypass pumping and/or diversion of sewage flows, cleaning and television inspection of sewers to be lined, liner installation, reconnection of service connections, all quality controls, provide samples for performance of required material tests, final television inspection, testing of lined pipe system and warranty work, all as specified herein.

1.1.2 The product furnished shall be a complete CIPP system including all materials, applicable equipment and installation procedures. The CIPP system manufacturer may submit, a minimum of 14 calendar days in advance of the bid date, required information to the Owner to obtain pre-approval status. Those CIPP systems that have been pre-approved will not be required to furnish information as required in the submittal section of these specifications unless specifically requested to do so by the Owner or if any of the CIPP system components have changed from those pre-approved by the Owner. All other CIPP systems or multi-component products will be required to meet the submittal requirements as contained herein.

1.1.3 The CIPP shall be continuous and joint-less from manhole to manhole or access point to access point and shall be free of all defects that will affect the long term life and operation of the pipe.

1.1.4 The CIPP shall fit sufficiently tight within the existing pipe so as to not leak at the manholes, at the service connections or through the wall of the installed pipe. If leakage occurs at the manholes or the service connections the Contractor shall seal these areas to stop all leakage using a material compatible with the CIPP as directed by the Owner at the price bid therefore in the Proposal. If leakage occurs through the wall of the pipe the liner shall be repaired or removed as recommended by the CIPP manufacturer. Final approval of the liner installation will be based on a leak tight pipe.

1.1.5 The CIPP shall be designed for a life of 50 years or greater.

1.1.6 The CIPP may be designed to resist external groundwater pressures only or as a fully structural stand alone pipe-within-a-pipe. If the design is for groundwater, only the design groundwater level is required for external loads If specified in the contract documents the installed CIPP shall be a structurally designed pipe within a pipe, meet or exceed all contract specified physical properties, fitting tightly within the existing pipe all within the tolerances specified. The installed CIPP shall withstand all applicable surcharge loads (soil overburden, live loads, etc.) and external hydrostatic (groundwater) pressure, if present, for each specific installation location.

1.1.7 The installed CIPP shall have a long term (50 year) corrosion resistance to the typical chemicals found in domestic sewage.

1.1.8 All existing and confirmed active service connections and any other service laterals to be reinstated as directed by the Owner shall be re-opened robotically or by hand in the case of man-entry size piping, to their original shape and to 90% of their original capacity. All over-cut service connections will be properly repaired to meet the requirements of these specifications.

1.1.9 All materials furnished, as part of this contract shall be marked with detailed product information, stored in a manner specified by the manufacturer and tested to the requirement of this contract.

1.1.10 Testing and warranty inspections shall be executed by the Owner. Any defects found shall be repaired or replaced by the Contractor.

1.1.11 The Contractor shall furnish all samples for product testing at the request of the Owner. The Owner shall take possession of the samples for testing and shall maintain the chain of custody, deliver the samples to an approved laboratory and pay for all material and product testing performed under this contract.

1.2 REFERENCES

1.2.1 The following documents form a part of this specification to the extent stated herein and shall be the latest editions thereof. Where differences exist between codes and standards, the requirements of these specifications shall apply. All references to codes and standards shall be to the latest revised version.

ASTM - F1216 Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube

ASTM - F1743 Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Pull in and inflate and Curing of a Resin-Impregnated Tube

ASTM - D543 Standard and Practice for Evaluating the Resistance of Plastics to Chemical Reagents

ASTM - D638 Standard Test Method for Tensile Properties of Plastics

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

ASTM - D792 Standard Test Methods for Density and Specific Gravity of Plastics by displacement.

ASTM - F2019-03 Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Pulled in Place Installation of Glass Reinforced Plastic (GRP) Cured-in-Place Thermosetting Resin Pipe (CIPP)

ASTM - D2122-98(2004) Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings

ASTM F2561 - 06 Standard Practice for Rehabilitation of a Sewer Service Lateral and Its Connection to the Main Using a One Piece Main and Lateral Cured-in-Place Liner

ASTM - D2990 Standard Test Methods for Tensile, Compressive, and Flexural Creep and Creep-Rupture of Plastics

ASTM - D3567-97(2002) Standard Practice for Determining Dimensions of Fiberglass (Glass-Fiber-Reinforced Thermosetting Resin) Pipe and Fittings

ASTM - D3681 Standard Test Method for Chemical Resistance of "Fiberglass (Glass Fiber Reinforced Thermosetting Resin) Pipe in a Deflected Condition

ASTM - D5813 Standard Specification for Cured-in Place Thermosetting Resin Sewer Pipe

1.3 PERFORMANCE WORK STATEMENT (PWS) SUBMITTAL

The Contractor shall submit, to the Owner, a Performance Work Statement (PWS) at the pre-construction meeting, which clearly defines the CIPP product delivery in conformance with the requirements of these contract documents. Unless otherwise directed by the Owner, the PWS shall at a minimum contain the following:

1.3.1 Clearly indicate that the CIPP will conform to the project requirements as outlined in the Description of Work and as delineated in these specifications.

1.3.2 Where the scope of work is specifically delineated in the contract documents, a detailed installation plan describing all preparation work, cleaning operations, pre-CCTV inspections, by-pass pumping, traffic control, installation procedure, method of curing, service reconnection, quality control, testing to be performed, final CCTV inspection, warrantees furnished and all else necessary and appropriate for a complete CIPP liner installation. A detailed installation schedule shall be prepared, submitted and conform to the requirements of this contract.

1.3.3 Contractor's description of the proposed CIPP lining technology, including a detailed plan for identifying all active service connections maintaining service, during mainline installation, to each home connected to the section of pipe being lined, including temporary service if required by the contract.

1.3.4 A description of the CIPP materials to be furnished for the project. Materials shall be fully detailed in the submittals and conform to these specifications and/or shall conform to the pre-approved product submission.

1.3.5 A statement of the Contractors experience. The Contractor shall have a minimum of three (3) years of continuous experience installing CIPP liners in pipe of a similar size, length and configuration as contained in this contract. A minimum of 150,000 linear feet of shop wet-out liner installation is required and minimum of 6 onsite wet-out installations are required as specifically applicable to this contract. The lead personnel including the superintendent, the foreman and the lead crew personnel for the CCTV inspection, resin wet-out, the CIPP liner installation, liner curing and the robotic service reconnections each must have a minimum of three (3) years of total experience with the CIPP technology proposed for this contract and must have demonstrated competency and

experience to perform the scope of work contained in this contract. The name and experience of each lead individual performing work on this contract shall be submitted with the PWS. Personnel replaced by the contractor, on this contract, shall have similar, verifiable experience as the personnel originally submitted for the project.

1.3.6 Engineering design calculations, in accordance with the Appendix of ASTM F-1216, for each length of liner to be installed including the thickness of each proposed CIPP. It will be acceptable for the Contractor to submit a design for the most severe line condition and apply that design to all of the line sections. These calculations shall be performed and certified by a, qualified, Professional Engineer. All calculations shall include data that conforms to the requirements of these specifications or has been pre-approved by the Owner.

1.3.7 Proposed manufacturers technology data shall be submitted for all CIPP products and all associated technologies to be furnished.

1.3.8 Submittals shall include information on the cured-in-place pipe intended for installation and all tools and equipment required for a complete installation. The PWS shall identify which tools and equipment will be redundant on the job site in the event of equipment breakdown. All equipment, to be furnished for the project, including proposed back-up equipment, shall be clearly described. The Contractor shall outline the mitigation procedure to be implemented in the event of key equipment failure during the installation process.

1.3.9 A detailed description of the Contractor's proposed procedures for removal of any existing blockages in the pipeline that may be encountered during the cleaning process.

1.3.10 A detailed public notification plan shall be prepared and submitted including detailed staged notification to residences affected by the CIPP installation.

1.3.11 An odor control plan shall be submitted, by the contractor, that will ensure that project specific odors will be minimized at the project site and surrounding area.

1.3.12 Compensation for all work required for the submittal of the PWS shall be included in the various pipelining items contained in the Proposal.

1.4 PRODUCT SUBMITTALS

1.4.1 Fabric Tube – including the manufacturer and description of product components.

1.4.2 Flexible membrane (coating) material – including recommended repair (patching) procedure if applicable.

1.4.3 Raw Resin Data - including the manufacturer and description of product components.

1.4.4 Manufacturers' shipping, storage and handling recommendations for all components of the CIPP System.

1.4.5 All MSDS sheets for all materials to be furnished for the project.

1.4.6 Tube wet-out & cure method including:

1.4.6.1 A complete description of the proposed wet-out procedure for the proposed technology.

1.4.6.2 The Manufacturer's recommended cure method - for each diameter and thickness of CIPP liner to be installed. The PWS shall contain a detailed curing procedure detailing the curing medium and the method of application.

1.4.7 Compensation for all work required for the submittal of product data shall be included in the Lump Sum price contained in the Proposal for Mobilization.

1.5 SAFETY

1.5.1 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.

1.5.2 The Contractor shall perform all of the Work in accordance with applicable OSHA standards. Emphasis shall be placed upon the requirements for entering confined spaces and with the equipment being utilized for pipe renewal.

1.5.3 The Contractor shall submit a proposed Safety Plan to the Owner, 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.

1.5.4 Compensation for all work required for the submittal of the Safety Plan shall be included in the various pipelining items contained in the Proposal.

1.6 QUALITY CONTROL PLAN (QCP)

1.6.1 A detailed quality control plan (QCP) shall be submitted to the Owner that fully represents and conforms to the requirements of these specifications. At a minimum the QCP shall include the following:

1.6.2 A detailed discussion of the proposed quality controls to be performed by the Contractor.

1.6.3 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.

1.6.4 Proposed procedures for quality control, product sampling and testing shall be defined and submitted as part of the plan.

1.6.5 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.

1.6.6 A scheduled performance and product test result reviews between the Contractor and the Owner at a regularly scheduled job meeting.

1.6.7 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.

1.6.8 Two (2) days of inspector training, by the CIPP system manufacture, for the Owners inspectors shall be provided. This training shall be prior to liner 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 lining work, the system manufacturer shall furnish a check list containing key elements of the CIPP installation criteria that is important for the Owners inspector to ensure that quality control and testing requirements are performed in accordance with the contract documents.

1.6.9 Compensation for all work required for the submittal of the QCP shall be included in the various pipelining items contained in the Proposal. Compensation for inspector training shall be included in the price bid therefore in the Proposal.

1.7 CIPP REPAIR/REPLACEMENT

1.7.1 Occasionally installations will result in the need to repair or replace a defective CIPP. The Contractor shall outline specific repair or replacement procedures for potential defects that may occur in the installed CIPP. Repair/replacement procedures shall be as recommended by the CIPP system manufacturer and shall be submitted as part of the PWS.

1.7.2 Defects in the installed CIPP that will not affect the operation and long term life of the product shall be identified and defined.

1.7.3 Repairable defects that may occur in the installed CIPP shall be specifically defined by the Contractor based on manufacturer's recommendations, including a detailed step-by-step repair procedure, resulting in a finished product meeting the requirements of these contract specifications.

1.7.4 Un-repairable defects that may occur to the CIPP shall be clearly defined by the Contractor based on the manufacturer's recommendations, including a recommended procedure for the removal and replacement of the CIPP.

1.8 AS-BUILT DRAWINGS

1.8.1 As-Built drawings, pre & post inspection videotapes and/or CD's shall be submitted to the Owner, by the Contractor within 2 weeks of final acceptance of said work or as specified by the Owner. As-Built drawings will include the identification of the work completed by the Contractor and shall be prepared on one set of Contract Drawings provided to the Contractor at the onset of the project.

1.8.2 As-Built drawings shall be kept on the project site at all times, shall include all necessary information as outlined in the PWS or as agreed to by the Owner and the Contractor at the start of the Contract and shall be updated as the work is being completed, and shall be clearly legible.

1.8.3 Compensation for all work required for the submittal and approval of As-Built Drawings shall be included in the various pipelining items contained in the Proposal.

1.9 WARRANTY

1.9.1 The materials used for the project shall be certified by the manufacturer for the specified purpose. The Contractor shall warrant the liner material and installation for a period of one (1) year. During the Contractor warranty period, any defect which may materially affect the integrity, strength, function and/or operation of the pipe, shall be repaired at the Contractor's expense in accordance with procedures included in Section 1.7 CIPP Repair/Replacement and as recommended by the manufacturer.

1.9.2 On any work completed by the contractor that is defective and/or has been repaired, the contractor shall warrant this work for (1) year in addition to the warrantee required by the contract.,

1.9.21.9.3 After a pipe section has been lined and for a period of time up to one (1) year following completion of the project, the Owner may inspect all or portions of the lined system. The specific locations will be selected at random by the Owner and will include all sizes of CIPP from this project. If it is found that any of the CIPP has developed abnormalities since the time of "Post Construction Television Inspection," the abnormalities shall be repaired and/or replaced as defined in Section 1.7 CIPP Repair/Replacement and as recommended by the manufacturer. If, after inspection of a portion of the lined system under the contract, problems are found, the Owner may televise all the CIPP installed on the contract. All verified defects shall be repaired and/or

replaced by the Contractor and shall be performed in accordance with Section 1.7 CIPP Repair/Replacement and per the original specifications, all at no additional cost to the Owner.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 The CIPP System must meet the chemical resistance requirements of theses contract documents.

2.1.2 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 CIPP system manufacturer to avoid damage. Damage includes, but is not limited to, gouging, abrasion, flattening, cutting, puncturing, or ultra-violet (UV) degradation. On site storage locations, shall be approved by the Owner. 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

2.2 FABRIC TUBE

2.2.1 The fabric tube shall consist of one or more layers of absorbent non-woven felt fabric, felt/fiberglass or fiberglass and meet the requirements of ASTM F 1216, ASTM F 1743, ASTM D 5813 & ASTM F2019. The fabric tube shall be capable of absorbing and carrying resins, constructed to withstand installation pressures and curing temperatures and have sufficient strength to bridge missing pipe segments, and stretch to fit irregular pipe sections. The contractor shall submit certified information from the felt manufacturer on the nominal void volume in the felt fabric that will be filled with resin.

2.2.2 The wet-out fabric tube shall have a uniform thickness and excess resin distribution that when compressed at installation pressures will meet or exceed the design thickness after cure.

2.2.3 The fabric tube shall be manufactured to a size and length that when installed will tightly fit the internal circumference, meeting applicable ASTM standards or better, of the original pipe. Allowance shall be made for circumferential stretching during installation. The tube shall be properly sized to the diameter of the existing pipe and the length to be rehabilitated and be able to stretch to fit irregular pipe sections and negotiate bends. The Contractor shall determine the minimum tube length necessary to effectively span the designated run between manholes. The Contractor shall verify the lengths in the field prior to ordering and prior to impregnation of the tube with resin, to ensure that the tube will have sufficient length to extend the entire length of the run. The Contractor shall also measure the inside diameter of the existing pipelines in the field prior to ordering liner so that the liner can be installed in a tight-fitted condition.

2.2.4 The outside and/or inside layer of the fabric tube (before inversion/pull-in, as applicable) shall be coated with an impermeable, flexible membrane that will contain the resin and facilitate, if applicable, vacuum impregnation and monitoring of the resin saturation during the resin impregnation (wetout) procedure.

2.2.5 No material shall be included in the fabric tube that may cause de-lamination in the cured CIPP. No dry or unsaturated layers shall be acceptable upon visual inspection as evident by color contrast between the tube fabric and the activated resin containing a colorant.

2.2.6 The wall color of the interior pipe surface of CIPP after installation shall be a light reflective color so that a clear detailed examination with closed circuit television inspection equipment may be made. The hue of the color shall be dark enough to distinguish a contrast between the fully resin saturated felt fabric and dry or resin lean areas.

2.2.7 Seams in the fabric tube, if applicable, shall meet the requirements of ASTM D5813.

2.2.8 The outside of the fabric tube shall be marked every 5 feet with the name of the manufacturer or CIPP system, manufacturing lot and production footage.

2.2.9 The minimum length of the fabric tube shall be that deemed necessary by the installer to effectively span the distance from the starting manhole to the terminating manhole or access point, plus that amount required to run-in and run-out for the installation process.

2.2.10 The nominal fabric tube wall thickness shall be constructed, as a minimum, to the nearest 0.5 mm increment, rounded up from the design thickness for that section of installed CIPP. Wall thickness transitions, in 0.5 mm increments or greater as appropriate, may be fabricated into the fabric tube between installation entrance and exit access points. The quantity of resin used in the impregnation shall be sufficient to fill all of the felt voids for the nominal felt thickness.

2.3 RESIN

2.3.1 The resin shall be a corrosion resistant polyester or vinyl ester resin and catalyst system or epoxy and hardener system that, when properly cured within the tube composite, meets the requirements of ASTM F1216, ASTM F1743 or F2019, the physical properties herein, and those, which are to be utilized in the design of the CIPP for this project. The resin shall produce CIPP which will comply with or exceed the structural and chemical resistance requirements of this specification.

2.3.2 The resin to tube ratio, by volume, shall be furnished as recommended by the manufacturer

2.4 STRUCTURAL REQUIREMENTS

2.4.1 The physical properties and characteristics of the finished liner 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 CIPP system which meets or exceeds the minimum properties specified herein:

2.4.2 The CIPP shall be designed as per ASTM F1216 Appendixes. The CIPP design shall assume no bonding to the original pipe wall.

2.4.3 The design engineer shall set the long term (50 year extrapolated) Creep Retention Factor at 50% of the initial design flexural modulus as determined by ASTM D-790 test method. This value shall be used unless the Contractor submits long term test data (ASTM D2990) to substantiate a higher retention factor.

2.4.4 The cured pipe material (CIPP) shall, at a minimum, meet or exceed the structural properties, as listed below.

2.5 MINIMUM PHYSICAL PROPERTIES

Property	Test Method	Cured Composite Per ASTM F1216	Cured Composite Per Design
Flexural Modulus of Elasticity (Short Term) (FeltTubes) Felt/Fiberglass, Fiberglass as recommended by the Manufacturer	ASTM D-790	250,000 psi	Contractor Value
Flexural Strength (Short Term)(Felt Tubes) Felt/Fiberglass, Fiberglass as recommended by the Manufacturer	ASTM D-790	4,500 psi	Contractor Value

2.5.1 The required structural CIPP wall thickness shall be based, as a minimum, on the physical properties of the cured composite and per the design of the Professional Engineer (see section 1.3.6) and in accordance with the Design Equations contained in the appendix of the ASTM standards, and the following design parameters:

Design Safety Factor	2.0 (1.5 for pipes 36" or larger)
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

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

2.5.3 The design soil modulus may be adjusted based on data determined from detailed project soil testing results as provided by the Owner in the contract documents.

PART 3 INSTALLATION

3.1 CONSTRUCTION REQUIREMENTS

3.1.1 Preparation, cleaning, inspection, sewage by-passing and public notification. The Contractor shall clean the interior of the existing host pipe prior to installation of the CIPP liner. All debris and obstructions, that will effect the installation and the final CIPP product delivery to the Owner, shall be removed and disposed of.

3.1.2 The CIPP liner shall be constructed of materials and methods, that when installed, shall provide a jointless and continuous structurally sound CIPP able to withstand all imposed static, and dynamic loads on a long-term basis.

3.1.3 The Contractor may, under the direction of the Owner, utilize any of the existing manholes in the project area as installation access points. If a street must be closed to traffic because of the location of the sewer, the Contractor shall furnish a detailed traffic control plan and all labor and equipment necessary. The plan shall be in conformance with the requirements of the local agency having jurisdiction over traffic control.

3.1.4 Cleaning of Pipe Lines - The Contractor shall remove all internal debris from the pipe line that will interfere with the installation and the final product delivery of the CIPP as required in these specifications. 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 pipe lines. 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. The Owner will designate a site for the disposal of all debris removed, from the Owner's sewer system, as a direct result of the cleaning operation. Unless otherwise specified by the Owner, the Contractor shall dispose off all debris at no charge. Should any dumping fees apply, the Contractor shall be compensated at the respective unit price bid in the Proposal for cleaning.

3.1.5 By-passing Existing Sewage Flows - The Contractor shall provide for the flow of existing mainline and service connection effluent around the section or sections of pipe designated for CIPP installation. With most small diameter pipelines, particularly on terminal sewers, plugging will be adequate but must be monitored on a regular basis to prevent backup of sewage into adjacent homes.
Service connection effluent may be plugged only after proper notification to the affected residence and may not remain plugged overnight. Installation of the liner shall not begin until the Contractor has installed the required plugs or a sewage by-pass 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 lining process has begun, existing sewage flows shall be maintained, until the resin/felt tube composite is fully cured, cooled down, full televised and the CIPP ends finished. The Contractor shall coordinate sewer bypass and flow interruptions with the Owner at least 14 days in advance and with the property owners and businesses at least 1 business day in advance. 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 Owner before proceeding with any CIPP installation. Compensation for by-pass pumping and all associated plans and approvals shall be at the price bid therefore in the Proposal.

3.1.6 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 Owner a copy of the pre-cleaning and post-cleaning video and suitable log, and/or in digital format for review prior to installation of the CIPP and for later reference by the Owner.

3.1.7 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 CIPP. If pre-installation inspection reveals an obstruction, misalignment, broken or collapsed section or sag that was not identified as part of the original scope of work and will prohibit proper installation of the CIPP, the Contractor may be directed by the Owner to correct the problem(s) prior to lining by utilizing open cut repair methods. The Contractor shall be compensated for this work under a contingency pay item designated for open cut point repairs. Removal of any previously unknown obstructions shall be considered as a changed condition. The cost of removal of obstructions that appeared on pre-bid video documentation and made available to the Contractor, prior to the bid

opening, shall be compensated for on a unit price basis in accordance with the contract documents.

3.1.8 The Contractor shall be responsible for confirming the locations of all branch service connections prior to installing and curing the CIPP. If required in the contract documents, each connection will be dye tested to determine whether or not the connection is live or abandoned. The cost for dye testing of existing service connections shall be compensated at the unit price bid in the Proposal for Dye Testing of Existing Service Connections. In the event the status of a service connection cannot be adequately defined, the Owner will make the final decision, prior to installation and curing of the liner, as to the status. Typically only service connections deemed "active" shall be reopened by the Contractor.

3.1.9 The Contractor shall be allowed use water from an owner-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.

3.2 INSTALLATION OF LINER

3.2.1 The CIPP Liner shall be installed and cured in the host pipe per the manufacturer's specifications as described and submitted in the PWS.

3.2.2 CIPP installation shall be in accordance with the applicable ASTM standards with the following modification:

3.2.3 The wet-out tube shall be positioned in the pipeline using the method specified by the manufacturer. Care should be exercised not to damage the tube as a result of installation. The tube should be pulled-in or inverted through an existing manhole or approved access point and fully extend to the next designated manhole or termination point.

3.2.4 Prior to installation and as recommended by the manufacturer remote temperature gauges or sensors shall be placed inside the host pipe to monitor the temperatures during the cure cycle. Liner and/or host pipe interface temperature shall be monitored and logged during curing of the liner.

3.2.5 To monitor the temperature of the liner wall and to verify correct curing and where specified by the contract documents, temperature sensors can be placed between the host pipe and the liner in the bottom of the host pipe (invert) throughout its length to monitor the temperature on the outside of the liner during the curing process. The temperature sensors can be placed at intervals as recommended by the sensor manufacturer. Additional sensors can be placed where significant heat sinks are likely or anticipated. The sensors, if installed, should be monitored by a computer using a tamper proof data base that is capable of recording temperatures at the interface of the liner and the host pipe.

3.2.6 Curing shall be accomplished by utilizing the appropriate medium in accordance with the manufacturer's recommended cure schedule. The curing source or in and output temperatures shall be monitored and logged during the cure cycles if applicable. The manufacturer's recommended cure method & schedule shall be used for each line segment installed, and the liner wall thickness and the existing ground conditions with regard to temperature, moisture level, and thermal conductivity of soil, per ASTM as applicable, shall be taken into account by the Contractor.

3.2.7 For heat cured liners, if any temperature sensor or multiple sensors do not reach the temperature as specified by the manufacturer to achieve proper curing or cooling, the installer can make necessary adjustments to comply with the manufacturer's recommendations. The system computer should have an output report that specifically identifies each installed sensor station in the length of pipe, indicates the maximum temperature achieved and the sustained temperature time. Each sensor should record both the maximum temperature and the minimum cool down temperature and comply with the manufacturers recommendations.

For UV Cured Liners, all light train sensor readings, recorded by the tamper proof computer, shall provide output documenting the cure along the entire length of the installed liner. The

cure procedure shall be in accordance with the manufacturers recommendation as included in the PWS submission by the contractor.

3.3 COOL DOWN

3.3.1 The Contractor shall cool the CIPP in accordance with the approved CIPP manufacturer's recommendations as described and outlined in the PWS.

3.3.2 Temperatures and curing data shall be monitored and recorded, by the Contractor, throughout the installation process to ensure that each phase of the process is achieved as approved in accordance with the CIPP System manufacturer's recommendations.

3.4 FINISH

3.4.1 The installed CIPP shall be continuous over the entire length of a sewer line section and be free from visual defects such as foreign inclusions, dry spots, pinholes, major wrinkles and de-lamination. The CIPP shall be impervious and free of any leakage from the pipe to the surrounding ground or from the ground to inside the lined pipe.

3.4.2 Any defect, which will or could affect the structural integrity or strength of the linings, shall be repaired at the Contractor's expense, in accordance with the procedures submitted under Section1.7 CIPP Repair/Replacement.

3.4.3 The beginning and end of the CIPP shall be sealed to the existing host pipe. The sealing material shall be compatible with the pipe end and shall provide a watertight seal.

3.4.4 If any of the service connections leak water between the host pipe and the installed liner, the connection mainline interface shall be sealed to provide a water tight connection.

3.4.5 If the wall of the CIPP leaks, it shall be repaired or removed and replaced with a watertight pipe as recommended by the manufacture of the CIPP system.

3.4.6 Compensation shall be at the actual length of cured-in-place pipe installed. The length shall be measured from center of manhole to center of manhole. The unit price per linear foot installed shall include all materials, labor, equipment and supplies necessary for the complete CIPP liner installation. Compensation for service connection sealing and pipe sealing at the manhole/wall interface, shall be at the unit price bid therefore in the Proposal.

3.5 MANHOLE CONNECTIONS AND RECONNECTIONS OF EXISTING SERVICES

3.5.1 A seal, consisting of a resin mixture or hydrophilic seal compatible with the installed CIPP shall be applied at manhole/wall interface in accordance with the CIPP System manufacturer's recommendations.

3.5.2 Existing services shall be internally or externally reconnected unless indicated otherwise in the contract documents

3.5.3 Reconnections of existing services shall be made after the CIPP has been installed, fully cured, and cooled down. It is the CONTRACTOR'S responsibility to make sure that all active service connections are reconnected.

3.5.4 External reconnections are to be made with a tee fitting in accordance with CIPP System manufacturer's recommendations. Saddle connections shall be seated and sealed to the new CIPP using grout or resin compatible with the CIPP.

3.5.5 A CCTV camera and remote cutting tool shall be used for internal reconnections. The machined opening shall be at least 90 percent of the service connection opening and the bottom of both openings must match. The opening shall not be more than 100 percent of

the service connection opening. The edges of the opening shall not have pipe fragments or liner fragments, which may obstruct flow or snag debris. In all cases the invert of the sewer connection shall be cut flush with the invert entering the mainline.

3.5.6 In the event that service reinstatements result in openings that are greater than 100 percent of the service connection opening, the Contractor shall install a CIPP type repair, sufficiently in size to completely cover the over-cut service connection. No additional compensation will be paid for the repair of over-cut service connections.

3.5.7 Coupons of pipe material resulting from service tap cutting shall be collected at the next manhole downstream of the pipe rehabilitation operation prior to leaving the site. Coupons may not be allowed to pass through the system.

3.5.8 Compensation shall be at the actual number of services re-connected using either internal or external means as contained in the Proposal. The unit price bid per service line re-connected shall be include all materials, labor, equipment and supplies necessary to complete the work as required in these specifications.

3.6 TESTING OF INSTALLED CIPP

3.6.1 The physical properties of the installed CIPP shall be verified through field sampling and laboratory testing. All materials for testing shall be furnished by the Contractor to the Owner for testing. All materials testing shall be performed at the Owner's expense, by an independent third party laboratory selected by the Owner as recommended by the CIPP manufacturer. All tests shall be in accordance with applicable ASTM test methods to confirm compliance with the requirements specified in these contract documents.

3.6.2 The Contractor shall provide samples for testing to the Owner from the actual installed CIPP liner. Samples shall be provided, at a minimum from one location per 1000 linear feet of CIPP installed or as required by the Owner. The sample shall be cut from a section of cured CIPP that has been inverted or pulled through a like diameter pipe which has been held in place by a suitable heat sink, such as sandbags. All curing, cutting and identification of samples will be witnessed by the Owner and transmitted by the Owner to the testing laboratory.

On pipelines greater than 18 inches in diameter the Owner may at its discretion, require plate samples cured with the CIPP or designate a location in the newly installed CIPP where the Contractor shall take a sample. The Opening produced from the sample shall be repaired in accordance with manufacturers recommended procedures.

3.6.3 The laboratory results shall identify the test sample location as referenced to the nearest manhole and station. Final payment for the project shall be withheld pending receipt and approval of the test results. If properties tested do not meet the minimum physical and thickness requirements, the CIPP shall be repaired or replaced by the Contractor unless the actual physical properties and the thickness of the sample tested meet the design requirements as required in the contract.

3.6.4 Chemical resistance - The CIPP system installed shall meet the chemical resistance requirements of ASTM D5813. CIPP samples tested shall be of fabric tube and the specific resin proposed for actual construction. It is required that CIPP samples without plastic coating meet these chemical testing requirements. A certification may be submitted, by the contractor, from the manufacturer, verifying that the chemical resistance of the CIPP meets the contract requirements.

3.6.5 Hydraulic Capacity - Overall, the hydraulic capacity shall be maintained as large as possible. The installed CIPP shall at a minimum be equal to the full flow capacity of the original pipe before rehabilitation. In those cases where full capacity cannot be achieved after liner installation, the Contractor shall submit a request to waive this requirement, together with the reasons for the waiver request. Calculated capacities may be derived using a commonly accepted roughness coefficient for the existing pipe material taking into consideration its age and condition.

3.6.6 The installed CIPP thickness shall be measured for each line section installed. If the CIPP thickness does not meet that specified in the contract and submitted as the approved design by the Contractor then the liner shall be repaired or removed unless the tested physical properties and the thickness of the sample tested meet the design requirements as required in the contract. The liner thickness shall have tolerance of minus 5% plus 10%. In man-entry size piping the Contractor shall remove a minimum of one sample or one sample every line section of installed CIPP, not meeting the specified design thickness, to be used to check the liner thickness. The samples shall be taken by core drilling 2-inch diameter test plugs at random locations selected by the Owner. As an alterative the Contractor may use industry proven, non-destructive methods for confirming the thickness of the installed CIPP.

3.6.7 All costs, to the Contractor, associated with providing cured CIPP samples for testing shall be included in the Lump Sum price bid for Mobilization.
Payment for all testing by a laboratory will be paid for, by the Owner, directly to the laboratory under the lump sum reserve for testing item force bid in the Bid Proposal.

3.7 FINAL ACCEPTANCE

3.7.1 All CIPP sample testing and repairs to the installed CIPP as applicable, shall be completed, before final acceptance, meeting the requirements of these specifications and documented in written form.

3.7.2 The Contractor shall perform a detailed closed-circuit television inspection in accordance with ASTM standards, in the presence of the Owner after installation of the CIPP liner and reconnection of the side sewers. A radial view (pan and tilt) TV camera shall be used. The finished liner shall be continuous over the entire length of the installation and shall be free of significant visual defects, damage, deflection, holes, leaks and other defects. Unedited digital documentation of the inspection shall be provided to the Owner within ten (10) working days of the liner installation. The data shall note the inspection date, location of all reconnected side sewers, debris, as well as any other defects in the liner, including, but not limited to, gouges, cracks, bumps, or bulges. If post installation inspection documentation is not submitted within Ten (10) working days of the liner installation, the Owner may at its discretion suspend any further installation of CIPP until the post-installation documentation is submitted. As a result of this suspension, no additional working days will be added to the contract, nor will any adjustment be made for increase in cost. Immediately prior to conducting the closed circuit television inspection, the Contractor shall thoroughly clean the newly installed liner removing all debris and build-up that may have accumulated, at no additional cost to the Owner.

3.7.3 Bypass pumping or plugging from the upstream manhole shall be utilized to minimize sewage from entering the line during the inspection. In the case of bellies in the line, the pipe shall be cleared of any standing water to provide continuous visibility during the inspection.

3.7.4 Where leakage is observed through the wall of the pipe, the contractor shall institute additional testing including but not limited to air testing, localized testing and any other testing that will verify that the leakage rate of the installed CIPP does not exceed acceptable tolerances specified in the contract.

3.8 TYPICAL BID ITEMS:

3.8.1 Mobilization – **Lump Sum** - Includes all PWS info, submittals, safety plan, as-built drawings, testing samples, mobilization/demobilization of labor, equipment and materials to the project site. Generally limited to 5% of the total amount bid for the project.

3.8.2 Pre-Lining CCTV Inspection – **Per linear foot** - Includes pre-cleaning and post cleaning CCTV for Owner review. Does not include CCTV inspection just prior to CIPP installation. All inspections will be performed by PACP trained and certified personnel.

3.8.3 Dye Testing of Service Connections – **Per each** -Includes dye testing and documentation of existing service connection on each pipe length to be lined.

3.8.4 Point Repairs – **Per each or by Lump Sum Contingency**- Includes excavation and restoration of a section or sections of pipe that are beyond rehabilitation using a CIPP. **Note:** Point repair items shall be categorized by pipe size, a minimum length of excavation and depth category of excavation to be paid for in the Proposal. If point repairs are not identified in the contract documents payment shall be on a contingency basis.

3.8.5 Standard Pipe cleaning – **Per linear foot** for each pipe size category – including all labor, equipment, materials and cost of material disposal.

3.8.6 Heavy Pipe Cleaning – Per linear foot for each pipe category – including all labor, equipment, materials and cost of material disposal.

3.8.7 Inspector training – Lump Sum – includes all labor equipment and materials required to train the Owner's inspectors on the technology to be installed for a period of two days.

3.8.8 Liner Installation – **Per linear foot** for each pipe size category - Includes all labor, equipment and materials required for the complete installation of a CIPP.

3.8.9 Traffic Control –**Lump Sum** – Includes all labor, equipment and material required to implement a traffic control plan for the entire project and shall include all costs associated sub-contracted traffic control specialists.

3.8.10 Sewage By-pass – **Lump Sum** – Includes all labor, equipment and materials required, to implement a sewage by-pass plan for the entire project, including the cost of all sub-contracted sewage by-pass specialists.

3.8.11 Service Reconnections – **Per each** – Includes reconnecting existing live sewer service connections to the installed CIPP. Owner shall review and verify those connections that are not live and will be left unopened.

3.8.12 Service connection sealing – **Per each** – Includes sealing the interface between the installed CIPP and the host pipe at the location of the service connection.

3.8.13 Manhole/Wall Interface Sealing – Per each – Includes sealing the interface between the installed CIPP and the manhole wall

3.8.13 Post Construction CCTV Inspection - **Per linear foot** - Includes post lining CCTV for submission to the Owner. All inspections will be performed by PACP trained and certified personnel.

3.8.14 Reserve for Testing – **Lump Sum Reserve** – For Owners use to include testing, required as directed by the Owner, under this contract by an independent laboratory. (The amount will be set by the Owner in the Bid Proposal)

END OF SECTION