

FOLDED (THERMOPLASTIC) PIPE (FP) INSTALLATION (HDPE, PVC, AND PVC TYPE A)

PERFORMANCE SPECIFICATION GUIDELINE

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PART 1 - GENERAL

- A. These Specifications include the minimum requirements for the rehabilitation of sanitary sewer pipelines by the installation of Folded (Thermoplastic) Pipe (FP) within an existing, deteriorated pipe as shown on the plans included as part of these contract documents.
- B. The rehabilitation of pipelines shall be done by the installation of a FP which, when installed, shall be continuous and tight-fitting throughout the entire length of the original pipe. The FP shall extend the full length of the original pipe and provide a structurally sound and water-tight new pipe within a pipe. The Contractor is responsible for proper, accurate and complete installation of the FP using the system selected by the Contractor.
- C. Neither the FP 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 production of any detrimental cuttings and 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 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 FP 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.
- D. 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, the FP in accordance with these specifications. All items of work not specifically mentioned herein which are required 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 in the Proposal.

1.1 DESCRIPTION OF WORK AND PRODUCT DELIVERY

- A. These Specifications cover all work necessary to furnish and install, a Folded (Thermoplastic) Pipe. 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, FP installation, reconnection of service connections, all quality controls, furnish samples for performance of required material tests, final television inspection, testing of lined pipe system and warranty work, all as specified herein.
- B. The product furnished shall be a complete FP System including all materials, applicable equipment and installation procedures. The FP system manufacturer can

submit, a minimum of 14 calendar days in advance of the bid date, required information regarding the FP Technology to the Owner to obtain pre-approval status. Those FP 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 FP system components have changed from those pre-approved by the Owner. All other FP systems or products will be required to meet the submittal requirements as contained herein.

- C. The FP shall be continuous and 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 normal operation of the pipeline.
- D. The FP shall fit tight within the existing pipe. If leakage occurs at the manholes or the service connection interface, the Contractor shall seal these areas to stop all leakage with a method recommended by the FP system manufacturer. If leakage occurs through the wall of the pipe, due to a defect, the FP shall be repaired or removed as recommended by the FP manufacturer. Final approval of the FP installation will be based on a tight fitting, structurally sound, leak tight pipe.
- E. The mainline FP shall be designed for a life of 50 years.
- F. Where specified in the contract documents, the FP may be designed as a FP to rehabilitate and enhance the existing pipe and withstand all external hydrostatic loads or as a fully structural stand alone pipe-within-a-pipe. Where indicated in the contract, the installed FP 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 structural FP shall withstand all applicable surcharge loads (soil overburden, live loads, etc.) and external hydrostatic (groundwater) pressure, if present, for each specific installation location.
- G. The installed FP shall have a long term (50 year) corrosion resistance to the typical chemicals found in domestic sewage.
- H. 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 no less than 95% of their original capacity. All service connection cuts shall match the flow line of the existing pipe. All over-cut service connections will be properly repaired to meet the requirements of these specifications.
- I. All materials furnished, as part of this contract shall be marked, as applicable, according to their respective ASTM product standards with detailed product information, stored in a manner specified by the manufacturer and tested to the requirement of this contract.

- J. Testing and warranty inspections shall be as specified and executed by the Owner. Any defects found shall be repaired or replaced by the Contractor.
- K. The Contractor shall furnish all samples for product testing. The Owner ensures the chain of custody and will pay for all material and product testing performed under this contract.

1.2 REFERENCES

- A. The following documents form a part of this specification to the extent stated herein and shall be the latest editions thereof. These specifications reference American Society of Testing and Materials (ASTM) standard specifications. Where differences exist between codes and standards, the requirements of these specifications shall apply.

D-638 Standard Test Method for Tensile Properties of Plastics.

D-790 Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

D-792 Standard Test Methods for Density and Specific Gravity of Plastics by displacement.

D-1784 Specification for Rigid Poly Vinyl Chloride (PVC) Compounds and Chlorinated Poly Vinyl Chloride (CPVC) Compounds

D-2122 Dimensions of Thermoplastic Pipe and Fittings

D-2412 Test Method for Determination of External Loading Characteristics of Pipe by Parallel-Plate Loading

D-2444 Standard Test Method for Determination of the Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight)

D-2657 Standard Practice for Heat Fusion Joining of Polyolefin, Pipe and Fittings.

D-2990 Standard Test Methods for Tensile, Compressive, and Flexural Creep and Creep-Rupture of Plastics.

D-3350 Standard Specification for Polyethylene Plastic Pipe and Fittings Materials.

F-1504 Standard Specification for Folded Poly (Vinyl Chloride) (PVC) Pipe for Existing Sewer and Conduit Rehabilitation

F-1533 Standard Specification for Deformed Polyethylene (PE) FP

F-1606 Standard Practice for Rehabilitation of Existing Sewers and Conduits with Deformed Polyethylene (PE) FP

F-1867 Standard Practice for Installation of Folded/Formed Poly (Vinyl Chloride) (PVC) Pipe Type A for Existing Sewer and Conduit Rehabilitation

F-1871 Standard Specification for Folded/Formed Poly (Vinyl Chloride) Pipe Type A for Existing Sewer and Conduit Rehabilitation

F-1947 Standard Practice for Installation of Folded Poly (Vinyl Chloride) (PVC) Pipe into Existing Sewers and Conduits

1.3 PERFORMANCE WORK STATEMENT (PWS) SUBMITTAL

- A. The Contractor shall submit, to the Owner, a Performance Work Statement (PWS) at the pre-construction meeting, which clearly defines the FP 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 A clear definition of the product, its performance and the quality level to be furnished. Clearly indicate that the FP will conform to the project requirements as outlined in the Description of Work and as delineated in these specifications.
 - 2 Where the scope of work is specifically delineated in the contract documents or after the Owner has defined the specific scope of work to be performed, a detailed installation plan describing all preparation work, cleaning operations, pre-CCTV inspections, by-pass pumping plan, traffic control plan, installation procedure, method of processing, service reconnection, quality control, testing to be performed, final CCTV inspection, warranties furnished and all else necessary and appropriate for a complete FP installation. A detailed installation schedule shall be prepared, submitted and conform to the requirements of this contract.
 - 3 A detailed plan for the identification of all active service connections and how the flow, from the connections, will be maintained during the lining process.
 - 4 A description of the FP 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 approval.
 - 5 A statement of the Contractor qualifications and experience: The contractor shall have a minimum 25,000 linear feet of documented experience installing Folded Pipe technology with at least 10,000 linear feet of a size similar to that contained in this contract and a minimum of three (3) municipal references that will confirm the contractor's performance and quality on three (3) separate completed projects.
 - 6 As an alternate the contractor shall have on-site support of a manufacturer's field service representative having a minimum of three (3) years and 150,000 linear feet of documented experience installing Folded Pipe technology of a size similar to that contained in this contract.
 - 7 The lead crew personnel including the superintendent and foreman shall have a minimum of one (1) year of documented experience and a minimum of three (3) references for each individual that will confirm the individual's performance on previously completed projects.
 - 8 In the event that the experience of the lead superintendent and/or foreman does not meet the requirements of this contract, the manufacturer shall provide a trainer/instructor meeting these requirements for the duration of the project.
 - 9 As an alternate the lead crew personnel including the superintendent and foreman shall have a minimum of two (2) years of documented experience.
 - 10 The lead CCTV, installation and cutter operator shall have a minimum of one (1) year of verifiable experience.
 - 11 The name and experience of each lead individual performing work on this contract shall be submitted with the PWS.

- 12 Engineering design calculations, shall be submitted, in accordance with the applicable ASTM specification design guidelines, for each length of FP to be installed including the thickness of each proposed section of FP. 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, Engineer. All calculations shall include data that conforms to the requirements of these specifications or has been pre-approved by the Owner.
 - 13 Proposed manufacturer's technology data shall be submitted for all FP products and all associated technologies to be furnished.
 - 14 Submittals shall include information on the FP 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.
 - 15 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.
 - 16 A detailed procedure for testing the water tightness of the installed FP system.
 - 17 A detailed public notification plan shall be prepared and submitted including detailed staged notification to residences affected by the FP installation.
- B. 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

- A. Pipe material including:
- 1 Manufacturer of the FP system
 - 2 Date of manufacture of the pipe
 - 3 Material cell classification
 - 4 Physical properties, including pipe stiffness, flexural modulus, flexural strength, and pipe dimensions both internal and external as applicable.
 - 5 MSDS sheets for all materials to be furnished for the project.
 - 6 Manufacturer's certification of conformance to the product specific ASTM standards.
 - 7 Recycled materials, other than the manufacturer's own clean, rework material, shall not be contained in the manufactured pipe to be installed.
- B. Method of pipe joining:

- 1 For heat fusion joined materials, certification, verification and documentation of conformance to ASTM D-2657 as applicable or appropriate.
- 2 FP system manufacturer's recommended end seal material to be used at manholes and sealing techniques to be used at service connection interface with the mainline to stop any leakage.

C. Fittings:

- 1 All fittings shall be of compatible materials with the FP system.
- 2 Detailed information from the fitting manufacturer must be provided indicating attachment procedures.
- 3 Fittings, once installed, must be leak-tight.

D. Manufacturers' shipping, storage and handling recommendations for:

- 1 FP
- 2 Lubricants required for installation if applicable
- 3 Fittings
- 4 End seal materials

E. Compensation for all work required for the submittal of product data shall be included in the Lump Sum Price Bid in the Proposal for Mobilization.

1.5 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 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 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.
- D. Compensation for all work required for the submittal of the Safety Plan shall be included in the price for the various pipelining items contained in the Proposal.

1.6 QUALITY CONTROL PLAN (QCP)

- A. 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 A detailed discussion of the proposed quality controls to be performed by the Contractor.
 - 2 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.
 - 3 Proposed procedures for quality control, product sampling and testing.
 - 4 Proposed methods for product performance controls, including method of and frequency of product sampling and testing both in delivered material and installed product form.
 - 5 Review of performance and product test results between the Contractor and the Owner at a regularly scheduled job meeting.
 - 6 Inspection forms and guidelines for quality control inspections which shall be prepared in accordance with the standards specified in this contract and submitted with the QCP.
 - 7 Two (2) days of inspector training, by the FP system manufacture, for the Owner's inspectors shall be provided. This training shall be at the beginning of the project, shall include both technical and field training and shall 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 pipelining, the system manufacturer shall furnish a check list containing key elements of the FP installation criteria that is important for the Owner's inspector to ensure quality control and testing requirements are performed in accordance with the contract documents.
 - 8 Compensation for all work required for the submittal of the QCP shall be included in the price for the various pipelining items contained in the Proposal.

1.7 FP REPAIR/REPLACEMENT

- A. Occasionally construction variables will result in the need to repair or replace a defective FP. The Contractor shall outline specific repair or replacement procedures for potential defects that may occur in the installed FP. Repair/replacement procedures shall be as recommended by the FP system manufacturer and shall be submitted as part of the PWS.
- B. Defects in the installed FP that will not affect the operation and long term life of the product shall be identified and defined by the Contractor based on the manufacturer's recommendations.
- C. Repairable defects that may occur in the installed FP 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.

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

1.8 AS-BUILT DRAWINGS

- A. As-Built drawings and pre & post inspection DVD'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.
- B. 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.
- C. 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

- A. The materials used for the project shall be certified by the manufacturer for the specified purpose. The manufacturer shall warrant the FP to be free from defects in raw materials for one (1) year from the date of installation and acceptance by the Owner. The Contractor shall warrant the FP installation for a period of one (1) year. During the Contractor warranty period any defect, which may materially affect the integrity, strength, function and operation of the pipe, shall be repaired at the Contractor's expense in accordance with procedures included in Section 1.7 FP Repair/Replacement.
- B. 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 clean and televise all or portions of the lined system. The specific locations will be selected at random by the Owner and may include all sizes of FP from this project. If it is found that any of the FP has developed abnormalities or defects since the time of "Post Construction Television Inspection," the abnormalities or defects shall be repaired or the pipe replaced as defined in Section 1.7 FP Repair/Replacement. If, after inspection of a portion of the lined system under the contract, problems are found, the Owner may televise all the FP installed on the contract. All verified defects shall be repaired or the pipe replaced by the Contractor and shall be performed in accordance with Section 1.7 FP

Repair/Replacement and per the original specifications, all at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 PIPE MATERIAL

- A. The FP installed shall meet the requirements and intent of the contract documents and conform to the product submittals furnished to and accepted by the Owner.
- B. The FP System must meet the chemical resistance requirements of these contract documents.
- C. The FP delivered to the job site shall, as a minimum contain, the manufacture name or trademark and code, the nominal outside diameter, the cell classification, the DR designation and the ASTM designation of the pipe.
- D. All materials, shipped to the project site, shall be accompanied by test reports, as requested by the Owner, certifying that the materials conform to the applicable ASTM standards listed herein. Materials shall be shipped, stored, and handled in a manner consistent with the PWS and the written recommendations of the FP system manufacturer to avoid damage. Damage may include, but is not limited to, gouging, abrasion, flattening, cutting, puncturing, or ultra-violet (UV) degradation. On site storage locations are to be selected by the Contractor and 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 STRUCTURAL REQUIREMENTS

- A. The physical properties, wall thickness and characteristics of the finished FP will vary according to the material installed. It shall be the responsibility of the Contractor to provide a FP system which meets or exceeds the minimum properties specified herein:
- B. The FP shall be designed as per the applicable ASTM Standard, depending on the material being installed. The FP design shall assume no bonding to the original pipe wall.
- C. The design engineer shall set the long term (50 year extrapolated) Modulus Retention Factor as a percentage of the flexural modulus as determined by ASTM D-790 test method. The Modulus Retention Factor shall be based on long term test data (ASTM D2990 or equal) submitted by the manufacturer of the product selected to substantiate the long term creep retention factor.

- D. The installed FP material shall, at a minimum, meet the structural properties, as listed below.

2.3 MINIMUM PHYSICAL PROPERTIES

Property	Test Method	Per Applicable ASTM
Flexural Modulus of Elasticity	ASTM D-790	HDPE - 118,000psi PVC - 280,000psi PVC Type A - 145,000psi
Flexural Strength	ASTM D-790	HDPE - N/A PVC - 5,000psi PVC Type A - 4,100psi

- A. The required structural FP wall thickness shall be based, as a minimum, on the physical properties of the manufactured FP and per the design of the Professional Engineer (see section 1.3.1.6) and in accordance with ASTM F1504, F1533 or F1871 as applicable and the following design parameters:

Design Safety Factor	2.0
Modulus Retention Factor	As submitted and specific to type of pipe material
Ovality	2% or as measured by field inspection
Constrained Soil Modulus	Per AASHTO LRFD Section 12 and AWWA Manual 45
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. (or data from specific project soil borings)
Minimum service life	50 years

- B. 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 FP system. 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.
- C. The design soil modulus and soil density may be adjusted based on data determined from detailed project soil testing results provided by the Owner.

PART 3 - INSTALLATION

3.1 CONSTRUCTION REQUIREMENTS

- A. The Contractor shall clean the interior of the existing host pipe prior to installation of the FP. All debris and obstructions, in the existing pipe, that will affect the intended function and the final FP product delivery to the Owner, shall be removed and properly disposed of.
- B. The FP shall be constructed of materials and with methods, that when installed, shall provide a continuous structurally sound FP able to withstand all imposed design loads on a long-term basis.
- C. The Contractor may, under the direction of the Owner, utilize any of the existing manholes in the project area as installation access points. If modification of the manhole is required to accommodate the installation of the FP, the cost of modification and restoration to the manhole's original condition will be at the contractor's cost. If a street must be closed to traffic because of the location of the sewer, the Contractor shall furnish a detailed traffic detour and 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.
- D. 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 FP 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 transport all debris, to the designated site, at no additional cost. Should any dumping fees apply, the Contractor shall make himself aware of the fees prior to the bid and shall be compensated at the respective unit price bid in the Proposal for cleaning.
- E. 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 FP installation. Service connection effluent may be plugged only after proper notification to the affected residence and may not remain plugged overnight. Installation of the FP shall not begin until the Contractor has installed 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 FP material is fully processed, is cooled down to ambient or below temperature, fully televised and the FP ends finished. The Contractor shall coordinate sewage bypass

and flow interruptions with the Owner at least 14 days in advance and with the property owners and businesses at least 3 business days in advance. The pump and bypass lines shall be of adequate capacity and size to handle peak flows. The Contractor shall submit details of the bypass plan and design to the Owner before proceeding with any FP installation. Compensation for by-pass pumping and all associated plans and approvals shall be at the price bid therefore in the Proposal.

- 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 Owner a copy of the post-cleaning/pre FP installation DVD and suitable log for review prior to installation of the FP and for later reference by the Owner.
- 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 FP. 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 FP, 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 included in the various unit price items bid in the contract documents.
- H. The Contractor shall be responsible for confirming the locations of all branch service connections prior to installing and processing the FP. 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 processing of the FP, as to the status. Typically only service connections deemed "active", by the Owner, shall be reopened by the Contractor.
- I. 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 used on the project.

3.2 INSTALLATION OF FP

- A. The FP shall be installed and processed in the host pipe per the manufacturer's specifications as described and submitted in the PWS.
- B. FP installation shall be in accordance with ASTM Standards as applicable to each specific pipe material.
- C. The FP shall be positioned in the pipeline using the method specified by the manufacturer. Care should be exercised not to damage the FP as a result of installation. The FP should be pulled-in through an existing manhole or access point and fully extend to the next designated manhole or termination point.
- D. Prior to installation and as recommended by the manufacturer temperature sensors shall be used to monitor the temperatures during the processing of the FP. Temperatures shall be monitored and logged during processing and cool down.
- E. Processing of the FP shall be accomplished by utilizing the appropriate medium in accordance with the manufacturer's recommendation. The heat source in and output temperatures shall be monitored and logged during the processing and cool down cycles. The manufacturer's recommended processing procedure, in accordance with the applicable ASTM installation standard, shall be used for each line segment installed. The FP wall thickness and the existing ground conditions with regard to temperature, moisture level, and thermal conductivity of the host pipe and soil, shall be taken into account by the Contractor during the installation of the FP. Pressures shall be adjusted according to site conditions to ensure a tight expansion out against the host pipe.
- F. The Contractor shall cool the FP in accordance with the approved manufacturer's recommendations as described and outlined in the PWS.
- G. Ambient temperatures, processing temperatures and processing pressures 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 FP system manufacturer's requirements.

3.3 FINISH

- A. The installed FP shall be fully expanded and continuous over the entire length of a sewer line section and be free from visual defects such as foreign inclusions, cracks, pinholes, major wrinkles and lifts. The FP shall be impervious and free of any leakage from the pipe to the surrounding ground or from the ground to inside the lined pipe.
- B. Any defect, which will or could affect the structural integrity or strength of the FP, shall be repaired or the pipe replaced at the Contractor's expense, in accordance with the procedures submitted under Section 1.7 FP Repair/Replacement.

- C. The beginning and end of the FP shall be sealed to the existing host pipe. The sealing material shall be compatible with the pipe end and shall provide a watertight seal.
- D. If any of the service connections leak water between the host pipe and the installed FP, the connection mainline interface shall be sealed to provide a water tight connection.
- E. If the wall of the FP leaks because of a defect, it shall be repaired or removed and replaced with a watertight pipe as recommended by the manufacturer of the system installed.
- F. Compensation shall be at the actual length of FP installed and accepted. 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 FP installation.

3.4 MANHOLE CONNECTIONS AND RECONNECTIONS OF EXISTING SERVICES

- A. A seal, consisting of a resin mixture, hydrophilic seal compatible with the installed FP or other system selected by the contractor shall be applied at manhole walls in accordance with the system manufacturer's recommendations. A hydrophilic gasket may be placed between the host pipe and the pipeliner.
- B. Existing services shall be internally reconnected unless indicated otherwise in the contract documents
- C. Reconections of existing services shall be made after the FP has been installed, fully processed, cooled down and dimensionally stable. It is the contractor's responsibility to make sure that all active service connections are reconnected.
- D. External reconections, if required, are to be made with a tee fitting in accordance with system manufacturer's recommendations. Compression fittings and saddle connections shall be leak-proof and seated and sealed to the new FP.
- E. A CCTV camera and remote reinstatement tool shall be used for internal reconections. The opening shall be at least 95 percent of the original 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 FP fragments, which may obstruct flow or snag debris.
- F. 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 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.

- G. Coupons of pipe material resulting from service tap reinstatement 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.
- H. Compensation shall be for 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 include all materials, labor, equipment and supplies necessary to complete the work as required in the specifications.

3.5 TESTING OF INSTALLED FP

- A. The physical properties of the installed FP 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 FP manufacturer. All tests shall be in accordance with applicable ASTM test methods and manufacturer's recommendations to confirm compliance with the requirements specified in these contract documents.
- B. The Contractor shall provide samples for testing to the Owner from the actual installed FP. Samples shall be provided, at a minimum from one location per 2500 linear feet of installed pipe. The sample shall be cut from a section of processed FP that has been installed through a like diameter pipe which has been held in place by a suitable heat sink, such as sandbags. All processing, cutting and identification of samples will be witnessed by the Owner and samples shall be immediately furnished to the Owner and transmitted by the Owner to the testing laboratory. The Owner will retain the chain of custody for samples to be tested.
- C. On pipelines greater in diameter than is practical to produce restrained samples, the Owner may at its discretion, designate a location in the newly installed FP where the Contractor shall take a sample. The Opening produced from the sample shall be repaired in accordance with manufacturer's recommended repair procedure.
- D. 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 timely and properly conducted test results. One re-testing, based on the manufacturer's recommendations will be permitted at the contractor's expense, for proper protocol compliance verification. If properties tested do not meet minimum requirements, the FP shall be repaired or replaced by the Contractor, at no additional cost to the Owner.

- E. Chemical resistance - The FP system installed shall meet the chemical resistance requirements for a typical domestic sewage environment. FP samples tested shall be of materials proposed for actual construction.
- F. Hydraulic Capacity - Overall, the hydraulic capacity shall be maintained as large as possible. The installed FP 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 FP installation, the Contractor shall request a waiver of 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.
- G. The installed FP thickness shall be measured for each line section installed. If the FP thickness does not meet that specified in the contract and submitted as the approved design by the Contractor then the FP shall be repaired or removed. The FP thickness shall have tolerance of minus 5% plus 10%. The Contractor may use industry proven, non-destructive methods for confirming the thickness of the installed FP.
- H. All costs, to the Contractor, associated with providing processed FP 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.

3.6 FINAL ACCEPTANCE

- A. All FP sample testing and repairs to the installed FP, as applicable, shall be completed, before final acceptance, meeting the requirements of these specifications and documented in written form.
- B. The Contractor shall perform a detailed closed-circuit television inspection in the presence of the Owner after installation of the FP and reconnection of the service connections. A radial view (pan and tilt) TV camera shall be used. The camera shall be panned 360 degrees around the circumference of the pipe and along the wall of the finished pipe at 10 foot intervals. The finished FP shall be continuous over the entire length of the installation and shall be free of significant visual defects, damage, deflection, holes, leaks, wrinkles and other defects. It is recognized that the new liner will conform to the shape and irregularities of the host pipe. Unedited digital documentation of the inspection shall be provided to the Owner within ten (10) working days of the FP installation. The data shall note the inspection date, location of all reconnected service connections, debris, as well as any other defects in the FP, 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 FP installation, the Owner may at its discretion suspend any further installation of FP 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. Prior to conducting the closed circuit television inspection, the Contractor shall thoroughly flush the newly installed FP removing all debris, shavings from cutting service connections and build-up that may have accumulated.

- C. 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 TYPICAL SUGGESTED BID ITEMS

- A. 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.
- B. 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 FP installation. All inspections will be performed by PACP trained and certified personnel.
- C. Dye Testing of Service Connections – Per each -Includes dye testing and documentation of existing service connection on each pipe length to be lined.
- D. 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 FP. 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.
- E. Standard Pipe cleaning – Per linear foot for each pipe size category – including all labor, equipment, materials and cost of material disposal.
- F. Heavy Pipe Cleaning – Per linear foot for each pipe category – including all labor, equipment, materials and cost of material disposal.
- G. FP Installation – Per linear foot for each pipe size category and wall thickness - Includes all labor, equipment and materials required for the complete installation of a FP.
- H. Traffic Control –Lump Sum – Includes all labor, equipment and material required to implement a traffic control plan for the entire project including the costs of all sub-contracted traffic control specialists.

- I. 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.
- J. Service Reconnections – Per each – Includes reconnecting existing live sewer service connections to the installed FP. Owner shall review and verify those connections that are not live and will be left unopened.
- K. Service connection sealing – Per each – Includes sealing the interface between the installed FP and the host pipe at the location of the service connection.
- L. 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.
- M. 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****