

DOCUMENT 00 91 13

ADDENDA

ADDENDUM NUMBER 1

DATE: August 20, 2015

PROJECT: Trenchless Pipe Repair

CONTRACT NUMBER: SD-2015-02

OWNER: The City of Durham

ENGINEER: Dana P. Hornkohl, P.E., CFM, Public Works Department

TO: Prospective Bidders

This Addendum forms a part of the Contract Documents and modifies the Bidding Documents dated July 20, 2015, with amendments and additions noted below.

Acknowledge receipt of this Addendum in the space provided in the Bid form. Failure to do so may disqualify the Bidder.

This Addendum consists of 27 pages.

CHANGES TO THE PROJECT MANUAL

1. Delete the Cover Sheet issued on July 20, 2015 and replace with the Cover Sheet issued with this Addendum on August 20, 2015 (attached to this Addendum).

DOCUMENT 00 01 10 - TABLE OF CONTENTS

2. Add the following document under CONTRACTING REQUIREMENTS, "00 91 13 Addendum No. 1."
3. Add the following section under SITE AND INFRASTRUCTURE SUBGROUP, DIVISION 30 – MISCELLANEOUS, "30 13 05 Pipe Rehabilitation via Spray Applied Cementitious Mortar."

DOCUMENT 00 41 43 – BID FORM – UNIT PRICE (SINGLE-PRIME CONTRACT)

4. Article 4: Delete the Unit Price Work Form on page 3 and replace with the Unit Price Work Form issued with this Addendum (attached to this Addendum). Items 202 through 207 now include a reference to Section 30 13 05.

DOCUMENT 00 52 15 – AGREEMENT FORM – EJCDC STIPULATED SUM (SINGLE-PRIME CONTRACT)

5. Article 1.5: Delete the Unit Price Work Form on page 3 and replace with the Unit Price Work Form issued with this Addendum (attached to this Addendum). Items 202 through 207 now include a reference to Section 30 13 05.

SECTION 30 12 05 – SOIL AND PIPE STABILIZATION WITH POLYURETHANE MATERIAL

6. Paragraph 2.1.A: Remove subparagraph 2.
7. Paragraph 3.1.B.1: Remove the existing paragraph and replace it with the text below.

“A geotechnical engineer with at least five (5) years of experience in polyurethane injection for void fill, soil and pipe stabilization must oversee and certify the work performed as part of this section.”

SECTION 30 13 00 – CURED-IN-PLACE PIPE (CIPP)

8. This section had an incorrect contract number in the header. The correct contract number is SD-2015-02. A replacement section with the correct contract number is attached to this Addendum.
9. Paragraph B: Add the following subparagraph.

“5. Section 30 13 05: Pipe Rehabilitation via Spray Applied Cementitious Mortar

SECTION 30 13 05 – PIPE REHABILITATION VIA SPRAY APPLIED CEMENTITIOUS MORTAR

10. This section is added to the Project Manual (attached to this Addendum).

END OF DOCUMENT

CITY OF DURHAM
PROJECT MANUAL

INCLUDING

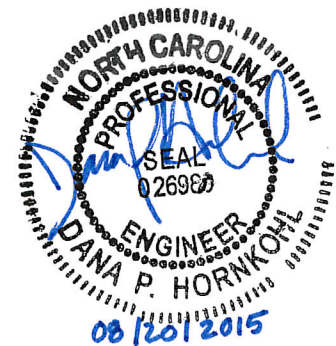
**BIDDING DOCUMENTS, CONTRACT DOCUMENTS, AND
TECHNICAL SPECIFICATIONS**

FOR

DURHAM



1869
CITY OF MEDICINE



CONTRACT: SD-2015-02
July 20, 2015, Revised August 20, 2015

Project:
Trenchless Pipe Repair

Stormwater & GIS Services Division
Public Works Department
101 City Hall Plaza, Durham NC 27701

SD-2015-02
Trenchless Pipe Repair
Unit Price Work Form

Item No.	Spec.	Item Description	Quantity	Unit	Unit Price	Item Value
201	30 13 00	Mobilization for Trenchless Pipe Repair	9	EA		
202	30 13 00 & 30 13 05	12-inch CIPP Repair	100	LF		
203	30 13 00 & 30 13 05	15-inch CIPP Repair	100	LF		
204	30 13 00 & 30 13 05	18-inch CIPP Repair	201	LF		
205	30 13 00 & 30 13 05	24-inch CIPP Repair	176	LF		
206	30 13 00 & 30 13 05	30-inch CIPP Repair	816	LF		
207	30 13 00 & 30 13 05	36-inch CIPP Repair	148	LF		
208	30 13 00	Service Reconnection	20	EA		
209	30 12 00	12-inch Pipe Joint Repair	3	EA		
210	30 12 00	15-inch Pipe Joint Repair	3	EA		
211	30 12 00	18-inch Pipe Joint Repair	3	EA		
212	30 12 00	24-inch Pipe Joint Repair	9	EA		
213	30 12 00	30-inch Pipe Joint Repair	12	EA		
214	30 12 00	36-inch Pipe Joint Repair	3	EA		
215	30 12 00	Additional Polyurethane Material	1,000	LB		
216	30 10 00	Mobilization for MS4 Inspections	10	EA		
217	30 10 00	MS4 Inspections	50	HR		
218	30 10 05	Cleaning for MS4 Inspections	25	HR		
219	30 11 00	Bulk Water Fire Hydrant Meter Annual Rental	1	EA	\$2,500.00	\$2,500.00
220	30 11 00	Testing and Inspecting Allowance	1	LS	\$5,000.00	\$5,000.00
TOTAL AMOUNT FOR CONTRACT SD-2015-02						

SECTION 30 13 00

CURED-IN-PLACE PIPE (CIPP)

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Unit Price Work – Measurement and payment.
 2. Description of work and product delivery.
 3. References.
 4. Performance Work Statement (PWS) submittal.
 5. Product submittals.
 6. Safety.
 7. Quality Control Plan (QCP).
 8. CIPP repair/replacement.
 9. As-Built drawings.
 10. Warranty.
- B. Related Sections:
1. Section 30 10 00: Municipal Separate Storm Sewer (MS4) Inspections
 2. Section 30 10 05: Storm Sewer Cleaning
 3. Section 30 11 00: Project Special Provisions.
 4. Section 30 12 05: Soil and Pipe Stabilization with Polyurethane Material
 5. Section 30 13 05: Pipe Rehabilitation via Spray Applied Cementitious Mortar
- C. These technical specifications include the minimum requirements for the rehabilitation of storm sewer pipelines by the installation of Cured-In-Place Pipe (CIPP) within the existing, deteriorated pipe as shown on the Drawings included as part of these Contract Documents.
- D. 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.
- E. 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 within the Municipal Separate Storm Sewer System (MS4). The Contractor shall notify the Engineer 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.

- F. 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 price work Bid.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

- A. Mobilization for Trenchless Pipe Repair:
1. Basis of Measurement: By each (EA).
 2. Basis of Payment: Includes the work described in NCDOT Standard Specification Section 800 that is specifically related to trenchless pipe repairs for each new location where trenchless pipe repairs are performed. Trenchless pipe repairs include cured-in-place pipe (CIPP) and pipe joint repairs. Five trenchless pipe repair locations have been identified in the Contract. An additional three locations are anticipated as part of the Work.
 3. Includes all traffic control, PWS info, submittals, safety plan, as-built drawings, testing samples, drainage bypassing, pre and post CIPP video inspection, mobilization/demobilization of labor, equipment and materials to the Project Site.
- B. Cured-In-Place Pipe:
1. Basis of Measurement: By hour (LF).
 2. Basis of Payment: Includes the work described in this specification and will be paid as the actual number of linear feet the Contractor's personnel actively installs.
- C. Service Reconnection:
1. Basis of Measurement: By each (EA).
 2. Basis of Payment: Includes the work described in this specification and will be paid as the actual number of reconnected existing live drainage service connections to the installed CIPP. Engineer shall review and approve live drainage connections prior to reconnection.
 3. Includes sealing the interface between the installed CIPP and the host pipe at the location of the service connection.

1.3 DESCRIPTION OF WORK AND PRODUCT DELIVERY

- A. These technical specifications 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 drainage 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.

- B. The product furnished shall be a complete CIPP system including all materials, applicable equipment and installation procedures.
- C. The CIPP shall be continuous and joint-less from structure to structure 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.
- D. The CIPP shall fit sufficiently tight within the existing pipe so as to not leak at the structures, at the service connections, or through the wall of the installed pipe. If leakage occurs at the structures 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 Engineer 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.
- E. The CIPP shall be designed for a life of 50 years or greater.
- F. 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.
- G. The installed CIPP shall have a long term (50 year) corrosion resistance to the typical chemicals found in municipal storm drainage.
- H. All existing and confirmed active service connections and any other service laterals to be reinstated as directed by the Engineer 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.
- I. 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.
- J. Testing and warranty inspections shall be executed by the Engineer. Any defects found shall be repaired or replaced by the Contractor.
- K. The Contractor shall furnish all samples for product testing at the request of the Engineer. The Contractor shall deliver the samples to an approved laboratory, and pay for all material and product testing performed under this Contract.

1.4 REFERENCES

- A. 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.
1. ASTM - F1216 Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube
 2. ASTM - F1743 Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Pull in and inflate and Curing of a Resin-Impregnated Tube
 3. ASTM - D543 Standard and Practice for Evaluating the Resistance of Plastics to Chemical Reagents
 4. ASTM - D638 Standard Test Method for Tensile Properties of Plastics
 5. ASTM - D790 Standard Test Methods for Flexural Properties of Un-reinforced and Reinforced Plastics and Electrical Insulating Materials
 6. ASTM - D792 Standard Test Methods for Density and Specific Gravity of Plastics by displacement.
 7. 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)
 8. ASTM - D2122-98(2004) Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings
 9. 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
 10. ASTM - D2990 Standard Test Methods for Tensile, Compressive, and Flexural Creep and Creep-Rupture of Plastics
 11. ASTM - D3567-97(2002) Standard Practice for Determining Dimensions of Fiberglass (Glass-Fiber-Reinforced Thermosetting Resin) Pipe and Fittings
 12. ASTM - D3681 Standard Test Method for Chemical Resistance of "Fiberglass (Glass Fiber Reinforced Thermosetting Resin) Pipe in a Deflected Condition
 13. ASTM - D5813 Standard Specification for Cured-in Place Thermosetting Resin Sewer Pipe

1.5 PERFORMANCE WORK STATEMENT (PWS) SUBMITTAL

- A. The Contractor shall submit, to the Engineer, a Performance Work Statement (PWS) at the pre-construction conference, which clearly defines the CIPP product delivery in conformance with the requirements of these contract documents. Unless otherwise directed by the Engineer, the PWS shall at a minimum contain the following items.
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.
 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, warranties 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.
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 service connected to the section of pipe being lined, including temporary service if required by the Contract.
 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.
 5. A statement of the Contractor's 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 on-site 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.
 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 as approved by the Engineer.
 7. Proposed manufacturers technology data shall be submitted for all CIPP products and all associated technologies to be furnished.
 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.
 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.
 10. A detailed public notification plan shall be prepared and submitted including detailed staged notification to residences affected by the CIPP installation.
 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.

- B. Compensation for all work required for the submittal of the PWS shall be included in the various pipelining items contained in the Bid.

1.6 PRODUCT SUBMITTALS

- A. Fabric Tube – including the manufacturer and description of product components.
- B. Flexible membrane (coating) material – including recommended repair (patching) procedure if applicable.
- C. Raw Resin Data - including the manufacturer and description of product components.
- D. Manufacturers' shipping, storage and handling recommendations for all components of the CIPP system.
- E. All Material Safety Data Sheets (MSDS) for all materials to be furnished for the project.
- F. Tube wet-out and cure method including the following items.
 - 1. A complete description of the proposed wet-out procedure for the proposed technology.
 - 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 including the curing medium and the method of application.
- G. Compensation for all work required for the submittal of product data shall be considered incidental to the Work.

1.7 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 Engineer, 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 considered incidental to the Work.

1.8 QUALITY CONTROL PLAN (QCP)

- A. A detailed quality control plan (QCP) shall be submitted to the Engineer that fully represents and conforms to the requirements of these specifications. At a minimum the QCP shall include the following items.
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 shall be defined and submitted as part of the plan.
 4. 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.
 5. A scheduled performance and product test result reviews between the Contractor and the Engineer at a regularly scheduled job meeting.
 6. 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.
 7. Two (2) days of inspector training, by the CIPP system manufacturer, for the Resident Project Representative 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 Resident Project Representative to ensure that quality control and testing requirements are performed in accordance with the Contract documents.
- B. Compensation for all work required for the submittal of the QCP and Resident Project Representative training shall be considered incidental to the Work.

1.9 CIPP REPAIR/REPLACEMENT

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

- D. 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.

1.10 AS-BUILT DRAWINGS

- A. As-Built drawings as well as pre and post inspection digital recordings shall be submitted to the Engineer, by the Contractor within 2 weeks of final acceptance of said work or as specified by the Engineer. As-Built drawings shall include the identification of the work completed by the Contractor and shall be prepared on one set of 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 Engineer 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 considered incidental to the Work.

1.11 WARRANTY

- A. 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 1.9, CIPP Repair/Replacement, and as recommended by the manufacturer.
- B. 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.
- C. After a pipe section has been lined and for a period of time up to one (1) year following completion of the Project, the Engineer may inspect all or portions of the lined system. The specific locations will be selected at random by the Engineer 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 installation inspection, the abnormalities shall be repaired and/or replaced as defined in Section 1.9, 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 Engineer 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 1.9, CIPP Repair/Replacement, and per the original specifications, all at no additional cost to the Owner.

PART 2 PRODUCTS

2.1 MATERIALS

- A. The CIPP System must meet the chemical resistance requirements of these Contract Documents.
- B. 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 Engineer. 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

- A. 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.
- B. 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.
- C. 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.
- D. 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 (wet-out) procedure.

- E. 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.
- F. 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.
- G. Seams in the fabric tube, if applicable, shall meet the requirements of ASTM D5813.
- H. 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.
- I. 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.
- J. 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

- A. 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.
- B. The resin to tube ratio, by volume, shall be furnished as recommended by the manufacturer.

2.4 STRUCTURAL REQUIREMENTS

- A. 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.
- B. The CIPP shall be designed as per ASTM F1216 Appendices. The CIPP design shall assume no bonding to the original pipe wall.

- C. The Contractor’s 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.
- D. The cured pipe material (CIPP) shall, at a minimum, meet or exceed the structural properties, as listed below.

Property	Test Method	Cured Composite per ASTM F1216	Cured Composite per Design
Flexural Modulus of Elasticity (Short Term) (Felt Tubes) 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 MINIMUM PHYSICAL PROPERTIES

- A. 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 Contractor’s Professional Engineer (see section 1.5.A.5) 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-inch or larger)
Creep Retention Factor	50%
Ovality	2% or as measure by field inspection
Constrained Soil Modulus	Per AASHTO LRFD Section 12 and AWWA Manual M 45
Groundwater Depth	As specified or indicated on the Drawings
Soil Depth (above the crown)	As specified or indicated on the Drawings
Live Load	Highway, railroad, or airport as applicable
Soil Load (assumed)	120-pounds/foot ³
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 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.
- C. The design soil modulus may be adjusted based on data determined from detailed Project soil testing results as provided by the Contractor. Soil testing results shall be approved by the Engineer.

PART 3 EXECUTION

3.1 CONSTRUCTION REQUIREMENTS

- A. Preparation, cleaning, inspection, drainage 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 affect the installation and the final CIPP product delivery to the Owner, shall be removed and disposed of.
- B. 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.
- C. The Contractor may, under the direction of the Engineer, utilize any of the existing drainage structures in the Project area as installation access points. If a street must be closed to traffic because of the location of the storm 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.
- 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 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 structure to structure 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 Engineer will designate a site for the disposal of all debris removed, from the Owner's drainage system, as a direct result of the cleaning operation. Unless otherwise specified by the Engineer, the Contractor shall dispose of all debris at no charge to the Owner. Dumping fees are incidental to the Work.
- E. By-passing Existing Drainage 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 storm sewers, plugging will be adequate but must be monitored on a regular basis to prevent backup of drainage 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 drainage by-pass system and all pumping facilities have been installed and tested under full operating conditions including the bypass of mainline and side storm sewer flows. Once the lining process has begun, existing drainage 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 storm sewer bypass and flow interruptions with the Engineer 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 Engineer before proceeding with any CIPP installation. By-pass pumping and all associated plans and approvals are incidental to the Work.

- 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 Engineer 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.
- 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 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 Engineer 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.
- H. The Contractor shall be responsible for confirming the locations of all branch service connections prior to installing and curing the CIPP. Each connection shall be dye tested to determine whether or not the connection is live or abandoned. Dye testing of existing service connections is incidental to the Work.
- I. Testing of Existing Service Connections - In the event the status of a service connection cannot be adequately defined, the Engineer 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.
- J. The Contractor shall be allowed use water from an Engineer-approved fire hydrant in the Project vicinity (see Section 30 11 00, Paragraph 1.3). 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

- A. The CIPP Liner shall be installed and cured in the host pipe per the manufacturer's specifications as described and submitted in the PWS.
- B. CIPP installation shall be in accordance with the applicable ASTM standards with the following modification.
- C. 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 structure or approved access point and fully extend to the next designated structure or termination point.
- D. 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.
- E. 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.
- F. 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.
- G. 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 manufacturer's recommendation as included in the PWS submission by the Contractor.

3.3 COOL DOWN

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

- A. 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.
- B. 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 Section 1.9, CIPP Repair/Replacement.
- C. 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.
- D. 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.
- E. 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.
- F. Compensation shall be at the actual length of cured-in-place pipe installed. The length shall be measured from center of structure to center of structure. 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 structure is incidental to the Work.

3.5 STRUCTURE CONNECTIONS AND RECONNECTIONS OF EXISTING SERVICES

- A. A seal, consisting of a resin mixture or hydrophilic seal compatible with the installed CIPP shall be applied at structure/wall interface in accordance with the CIPP system manufacturer's recommendations.
- B. Existing services shall be internally or externally reconnected unless indicated otherwise in the Contract Documents.
- C. Reconections 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.

- D. 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.
- E. 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 connection shall be cut flush with the invert entering the mainline.
- 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 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.
- G. Coupons of pipe material resulting from service tap cutting shall be collected at the next structure 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 at the actual number of services re-connected using either internal or external means as contained in the Bid. 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 these specifications.

3.6 TESTING OF INSTALLED CIPP

- A. 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. All materials testing shall be performed at the Contractor's expense, by an independent third party laboratory approved by the Engineer 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.
- B. The Contractor shall provide samples for testing to the Engineer 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 Engineer. 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 Engineer and transmitted by the Contractor to the testing laboratory. On pipelines greater than 18-inches in diameter the Engineer 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.
- C. The laboratory results shall identify the test sample location as referenced to the nearest structure 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.

- D. 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.
- E. 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.
- F. 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 Engineer. As an alternative the Contractor may use industry proven, non-destructive methods for confirming the thickness of the installed CIPP.
- G. All costs, to the Contractor, associated with providing cured CIPP samples for testing are considered incidental to the Work. Payment for all testing by a laboratory will be paid for, by the Contractor, directly to the laboratory.

3.7 FINAL ACCEPTANCE

- A. 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.
- B. The Contractor shall perform a detailed closed-circuit television inspection in accordance with ASTM standards, in the presence of the Engineer after installation of the CIPP liner and reconnection of the services. 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 Engineer within ten (10) working days of the liner installation. The data shall note the inspection date, location of all reconnected services, 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 Engineer 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.

- C. Bypass pumping or plugging from the upstream manhole shall be utilized to minimize drainage 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.
- D. 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.

END OF SECTION

SECTION 30 13 05

PIPE REHABILITATION VIA SPRAY APPLIED CEMENTITIOUS MORTAR

PART 1 GENERAL

1.1 SUMMARY

- A. This specification document contains the minimum material requirements and installation techniques required for pipe lining rehabilitation /repair to storm drainage pipe via spray applied cementitious mortar. This specification may be used in lieu of portions of Section 30 13 03, Cured-In-Place Pipe (CIPP) for pipe sizes of 24-inches in diameter and larger. No adjustment shall be made to the unit price for CIPP when this specification is used.
- B. Related Sections:
 - 1. Section 30 10 00: Municipal Separate Storm Sewer (MS4) Inspections
 - 2. Section 30 10 05: Storm Sewer Cleaning
 - 3. Section 30 11 00: Project Special Provisions.
 - 4. Section 30 12 05: Soil and Pipe Stabilization with Polyurethane Material
 - 5. Section 30 13 00: Cured-In-Place Pipe (CIPP)

1.2 DELIVERY, STORAGE, AND HANDLING

- A. All materials shall be delivered to the Site in their original, unopened packages, clearly labeled with the manufacturer's identification, printed instructions and batch code for shelf life and traceability.
- B. Store and condition the specified product as per the appropriate product data sheet.
- C. For handling instructions, refer to the Material Safety Data Sheet.

1.3 PROJECT SITE CONDITIONS

- A. Refer to Part 3 – Execution, or contact the manufacturer directly for any physical or environmental limitations required by the product.

1.4 QUALITY ASSURANCE

- A. The manufacturer shall have been in the business of manufacturing high performance cement-based repair mortars for over fifteen (15) years, maintain a strict quality assurance program in accordance with ISO 9001:2008, offer technical services, and provide a representative at the Project Site for product training, prior to product installation.
- B. Contractor shall submit to the Engineer, at least three references where the Contractor has successfully completed similar applications.

PART 2 PRODUCTS

2.1 MATERIALS

- A. The pipe lining/rehabilitation material shall be a centrifugally spray-applied, pre-packaged cement-based mortar containing a corrosion inhibitor requiring only the addition of potable water. The material shall not contain any chlorides or lime other than amounts contained within the hydraulic cement composition. The manufacturer shall be ISO 9001:2008 certified and have at least fifteen (15) years of experience in the manufacture of cementitious repair materials. The manufacturer shall offer technical services and provide a representative at the Project Site for product training prior to product installation upon advance notice.
- B. The pipe lining/rehabilitation material shall meet all the following typical performance criteria when cured at 70°F (21°C):
1. Compressive Strength, ASTM C 109
 - a. 1 Day: 3,000 psi (20.7 MPa)
 - b. 7 Days: 6,000 psi (41.4 MPa)
 - c. 28 Days: 8,000 psi (55.2 MPa)
 2. Bond Strength, ASTM C 882
 - a. 7 Days: 2,000 psi (13.8 MPa)
 3. Length Change, ASTM C 157
 - a. 28 Days Wet: +0.05%
 - b. 28 Days Dry: -0.15%
 4. Chloride Ion Permeability, ASTM C 1202
 - a. 28 Days: Very Low
 5. Freeze/Thaw Resistance, ASTM C 666A: 90% RDM @ 300 cycles
 6. Working Time: 30 minutes
- C. Subject to meeting the performance criteria stated above, other products may be formally submitted to the Engineer for approval as directed in Paragraph 6.05 of the General Conditions. All requests for approval shall contain certified test data verifying conformance with this specification. Three references of successfully completed projects of similar nature and scope of the work detailed in this specification shall be provided. The testing laboratory shall certify to any modifications made to the tests performed and provide details of modifications.

PART 3 EXECUTION

3.1 PIPE CONDITIONS

- A. Completely remove or mitigate all obstructions that may hinder proper installation of product prior to commencing work.
- B. Ensure all active water flow is diverted or stopped prior to commencing work.
- C. Completely remove all loose, delaminated and weak materials including dirt and debris from work area. Prepare pipe surfaces using high pressure water blasting to thoroughly

remove all contaminants and bond-inhibiting materials. Severely corroded pipe sections may need replacement. Metal surfaces may be blasted to a near-white finish; concrete surfaces should be mechanically prepared to an ICRI Concrete Surface Profile (CSP) of 6 or greater. Metal surfaces may require treating with a corrosion inhibitor after surface prep if they will not be repaired immediately.

- D. The sections to be repaired should be free of standing water; concrete pipe should be presoaked for 6 – 8 hours prior to material installation.
- E. All cracks in pipes identified shall be brought to the attention of the Engineer and a determination made of whether the cracks are subject to movement and may compromise the installation. The cracks shall be repaired or mitigated as directed prior to application of the pipe lining rehabilitation material.
- F. All existing joints in pipe shall be maintained.
- G. All surfaces must be blown clean from surface preparation debris and residue prior to commencing work.
- H. Due to the potential corrosion reactivity between cementitious materials and aluminum, all aluminum pipe should be coated with a coal tar type coating (or similar material) prior to application of mortar.
- I. For more detailed information, refer to the following source: "Surface Preparation Guidelines for the Repair of Deteriorated Concrete Resulting from Reinforcing Steel Oxidation", Report of International Concrete Repair Institute, March 1995.

3.2 ENVIRONMENTAL CONDITIONS

- A. Condition and maintain all materials and surfaces that contact pipe lining rehabilitation material to between 50°F and 90°F (10°C and 32°C), but optimally between 60°F and 75°F (15°C and 24°C) whenever possible.

3.3 EQUIPMENT AND MATERIALS

- A. All necessary tools, equipment and materials shall be in good condition and as close as possible to area being repaired.
- B. Appropriate clothing and safety equipment shall be worn to avoid breathing dust and prevent eye and skin contact with both dry and mixed repair materials.
- C. An ample source of potable water shall be available for preconditioning, mixing, cleaning and curing.

3.4 MIXING

- A. Mortar Mixer (Stationary Barrel with Moving Paddles)

1. Provide an adequate number of mortar mixers in good operating condition for uninterrupted placement. Do not exceed one-half the maximum capacity of the mortar mixer.
2. Pre-wet mortar mixer, empty excess water.
3. Start by adding the minimum amount of premeasured potable water to mixer. While mixing, slowly add pipe lining rehabilitation material and mix to a uniform consistency.
4. Mix thoroughly for approximately 3 to 4 minutes. To achieve desired consistency, add remaining water if necessary. Do not exceed maximum water content as stated on product packaging or an amount that will cause segregation.
5. Do not mix more material than can be placed within the working time of the repair material. Do not re-temper the mix by adding additional water.
6. A trial mix should be considered to optimize water content and application ability.

3.5 APPLICATION

- A. Position spray cast equipment within pipe center and begin pumping material to nozzle. Commence application of material around pipe. As material is cast around pipe, move applicator head accordingly so as to provide the necessary thickness and uniformity specified.
- B. Movement of the applicator head may be adjusted at any time to ensure proper coverage, thickness and uniformity.
- C. Coverage thicknesses may be verified at any point during installation to ensure movement rate of applicator head is correct.
- D. Placement shall be a continuous to minimize or prevent cold joints except over existing joints.

3.6 CURING

- A. Wet cure for 24-48 hours after placement or apply curing compound meeting the requirements of ASTM C 309 immediately after placement.
- B. Repair material shall be protected from freezing, hydrostatic pressure and vibration as recommended by the manufacturer.

3.7 EXTREME WEATHER CONDITIONS

- A. COLD WEATHER REPAIRS
 1. All surfaces shall be preconditioned and maintained between 50°F and 90°F (10°C and 32°C) and materials conditioned to between 50°F and 80°F (10°C and 27°C). Higher substrate and material mix temperatures will result in faster strength development. Due to the mass of palletized material and bulk packaging, up to 72 hours of conditioning may be required. Presoak area with hot water where applicable.

2. Heating the repair area may be accomplished by indirect exposure. Heated enclosures must be windproof and weatherproof. Combustion heaters must be vented and shall not be permitted to heat and dry the concrete locally. Caution: Exhaust gases may contaminate or cause carbonation within the enclosed environment. Ensure repair material does not dry out during heating.
3. Maintain temperature above 50°F (10°C) minimum until material reaches 1000 psi (6.9 MPa) or the minimum required strength.
4. Gradually allow temperature of material to cool to ambient temperature to avoid thermal shock.
5. Reference: ACI 306R-88, "Cold Weather Concreting."

B. HOT WEATHER REPAIRS

1. Materials shall be conditioned as necessary so that the mixed material is between 50°F and 90°F (10°C and 32°C). Due to the mass of palletized material and bulk packaging, up to 72 hours of conditioning may be required.
2. All surfaces in contact with material must be preconditioned and maintained below 90°F (32°C).
3. Cooling of surfaces, materials and equipment can be accomplished by using iced water for mixing and presoaking concrete. Do not put ice directly into repair material. Shade area from direct sunlight or pour material when temperatures are decreasing.
4. Wind breaks shall be provided when necessary to prevent rapid evaporation.
5. Repair material shall remain protected and curing shall be dependent on specified product. Cure repair material in accordance with manufacturer's recommendations.
6. Reference: ACI 305R-91, "Hot Weather Concreting."

END OF SECTION