

**RECONSTRUCTION OF EXISTING WATER MAIN USING
CURED-IN-PLACE PIPE LINING METHOD**
SANEXEN INC. (AQUA-PIPE CIPP)

(1) INTENT

It is the intent of this section to provide for the reconstruction of existing water mains by the installation of a resin-impregnated flexible tube that is inflated within the existing pipe to form a hard, impermeable, corrosion resistant pipe within a pipe. When cured, the cured-in-place-pipe (CIPP) will be formed to the original water main.

(2) REQUIREMENTS

(A) DESCRIPTION OF WORK

All work shall comply with the terms of this specification and with the manufacturer's standards set forth for cured-in-place-pipe lining method selected by the Contractor and approved by the Engineer.

Under this method the Contractor shall reconstruct existing water mains by the insertion of a flexible lining tube consisting of two concentric, tubular, woven seamless polyester jackets with a watertight polymeric membrane bonded to the interior layer. Prior to installation, the tube will be impregnated and saturated with a thermosetting resin. The liner shall be inserted into the existing water main either by direct inversion (ASTM F1216) using a head of water, or by pulling the tube into place by winching and then inflating it (ASTM F1743). The shaping of the liner may be achieved by pushing a pig through the hose using water pressure. The thermosetting resin shall then be cured only by circulating hot water through the tube to cure the resin into a hard impermeable pipe. Use of hot air or circulating steam shall not be permitted during installation process.

Any cost associated with the removal of the unsatisfactorily installed liner and the subsequent, satisfactory reinstallation of an approved liner shall be borne solely by the Contractor, and he shall not make any claim against the City for this additional required work.

Once installed, the liner shall extend from start to end points specified in a continuous tight fitting watertight pipe-within-a-pipe, and the service connections shall be re-opened. During the warranty period any defects that might affect the integrity or strength of the liner shall be immediately repaired or replaced by the Contractor, at his expense, pursuant to the manufacturer's recommendations, and to the satisfaction of the Engineer.

(B) REFERENCE SPECIFICATIONS AND STANDARDS

The latest editions and revisions of ASTM D638, D790, F1216 and F1743, and NSF/ANSI 61 and the manufacturer's standards are hereby made a part of this specification.

(C) DELIVERY, STORAGE, AND HANDLING

- (1) The Contractor shall transport, handle, and store liner and thermosetting resin as recommended by manufacturer.
- (2) The Contractor shall deliver, store and handle other materials as recommended by the manufacturers to prevent damage.

(D) QUALIFICATIONS

Product

The product installed shall be certified by NSF to ANSI/NSF Standard 61 and shall be listed on the **NSF website accordingly**. The product installed shall meet the requirements of (Sect G) and shall have been commercially proven with a 5 year history of installations in North America and a minimum footage installed of 750,000 linear feet.

Installer

The Contractor shall be certified by the cured-in-place-pipe liner manufacturer that the Contractor is a fully trained user of the liner method. Installation of the liner method shall be performed by trained personnel. Such training shall have been conducted by a qualified representative of the liner method manufacturer. Certificates of such training for

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all personnel involved in the operation of the liner method shall be provided to the Engineer prior to the start of liner installation. The Installer must also satisfy all insurance, financial, and bonding requirements of the Owner. Acceptable documentation supporting the above must be submitted to the Owner.

(E) LINER SIZE AND LENGTH

The liner shall be fabricated to a size that when installed will neatly fit the internal circumference of the water main to be lined. The liner thickness shall be designed to adequately resist the full internal pressure and all external pressures and conditions (e.g. deflection, ring bending, buckling and minimum stiffness). The length of the liner shall be that deemed necessary to effectively span the distance and carry out the insertion and seal of the liner at the end points. The Contractor shall verify the lengths in the field before cutting the liner to length. Prior to the start of work the manufacturer of the cured-in-place-pipe liner will be required to submit design calculations for wall thickness to the Engineer.

Allowance for circumferential and longitudinal stretching of the liner during insertion shall be made as per the manufacturer's standards.

(F) DESIGN PARAMETERS

The following design parameters shall be used in the design of pipe liners in addition to the manufacturer's standards and ASTM F1216:

(1) Ovality of Existing Pipe	2%
(2) Existing Pipe Condition	Fully Deteriorated
(3) Modulus of Soil Reaction	700 psi Minimum
(4) Factor of Safety Against Buckling	2
(5) Live Load	AASHTO HS20-44 Loading under roadways AASHTO E-80 Loading under railroads
(6) Soil Unit Weight	120 pcf Minimum (If no boring data is available in vicinity.)
(7) Creep Reduction Factor	50%
(8) Internal Pressure	System working pressure
(9) Depth of cover	Actual depth of pipe

Liner material shall be tested in accordance with ASTM F1216, Section 8 – Inspection Practices. Certificates of tests shall be provided to the Engineer.

(G) LINER MATERIAL

The cured-in-place-pipe liner shall be composed of two concentric, tubular, woven and seamless polyester jackets with a seamless polymeric membrane bonded to the interior. The polymeric inner membrane shall be designed to ensure water tightness. The fully cured-in-place-pipe liner shall conform to the minimum structural standards as follows:

Tensile Strength @ Yield	3,000 psi	(ASTM D638)
Flexural Strength	4,500 psi	(ASTM D790)
Flexural Modulus	250,000 psi	(ASTM D790)

The Contractor shall furnish, prior to use of the lining materials, satisfactory written guarantee of his compliance with these specifications and the liner manufacturer's standards for all materials (woven and seamless polyester jackets, watertight polymeric membrane bonded to the interior, and the thermosetting resin) and techniques being used in the method.

Prior to the start of work the Contractor will be required to submit to the Engineer the types of resins and the resultant cure schedules for each length and size of water main to be lined. The finished liner shall incorporate thermosetting materials that will withstand the corrosive effects of normal existing chemical additives to the water supply.

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(H) SAFETY

The Contractor shall carry out his operations in strict accordance with all OSHA and manufacturer's safety requirements. Emphasis shall be placed upon safety requirements for entering confined spaces and working with hot water.

The Contractor shall erect such signs and other devices as are necessary for the safety of the work site and shall secure the site and perform all work to the safety requirements of all pertinent regulatory agencies.

(I) AIR QUALITY

The Contractor is advised that all liner installation work shall be carried out in full compliance with all City, State, and Federal laws, rules, and regulations regarding Air Quality and Safety.

(J) TEMPORARY WATER SERVICE

Prior to the start of construction the Contractor shall submit to the Engineer for approval his method of providing temporary water service to customers and to emergency fire crews. This shall include the Contractor's method to provide maintenance and protection during the entire length of the contract to ensure continued water service.

The temporary water line shall be disinfected and acceptable samples obtained and approved by the Engineer prior to connection to the customers.

(K) PREPARATION OF EXISTING WATER MAIN

(1) EXCAVATION OF INSERTION/EXTRACTION PITS, REMOVAL OF PIPE, AND ROUTE SURVEY

The exact location of insertion/extraction pits shall be as shown, specified or ordered and shall be of a length and width as recommended by the pipe liner manufacturer and as approved by the Engineer.

The Contractor shall excavate the insertion/extraction pits at the locations and to the dimensions specified and approved.

The Contractor shall excavate and remove the minimum length of pipe necessary for the liner insertion and receiving operations as per manufacturer's recommendations and as ordered by the Engineer.

The existing main shall be cut square using an approved cutting machine, leaving no split or fractured ends. All cut faces of the existing main shall be chamfered on the inside surface to a suitable profile to prevent damage to the liner pipe during or after insertion.

Edge guards or other means of protecting the liner from host pipe edges at insertion points must be submitted to the Engineer for review and approval.

A thorough examination of the route of the existing water main shall be made by after cutting of the main. This should include a pipeline location survey with equipment for locating any changes in direction, valves, bends, intrusions, and other fittings that may impede the insertion and/or proper inflation of the cured-in-place-pipe liner.

(2) CLEANING

The cleaning of the existing water main is a critical step in the reconstruction of the existing water main with a cured-in-place-pipe liner method. It is anticipated that the existing water main will have a fair amount of rust and scale deposits on the inside walls of the pipe.

The Contractor shall clean the existing water mains using a cleaning method that is approved by the Engineer. The cleaning method shall remove all rust, scales, tuberculation, deposits, loose or deteriorated remains of any original coatings and other foreign materials from the inside of the pipe so as to produce a smooth metal surface finish that will allow the new composite liner to adhere to the existing host pipe.

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After cleaning, and again immediately before pipe liner insertion the main shall be plunged with a tight fitting rubber plunger and foam swab to clear the pipe bore of debris and water.

(L) TELEVISION INSPECTION PRIOR TO INSTALLATION

The Contractor shall perform a television inspection and video recording of the existing water main after the cleaning of the water main is completed. This inspection will be performed, utilizing a radial eye camera, to determine that the rust and scale deposits have been adequately removed, that the latest condition of the water main makes lining feasible, to check for leaking service connections, and to accurately identify the location of service connections. Each service connection location shall be logged for use when re-opening of service connections is required.

(M) WATER SERVICE CONNECTIONS

- (1) Prior to installation of the cured-in-place-pipe liner the Contractor shall locate all existing water service laterals, and plug the service laterals as recommended by the manufacturer and approved by the Engineer. The insertion of plugs into the service connections may be done simultaneous with the above mentioned television inspection. The plugs are inserted so as to prevent any accumulation of epoxy inside the service line thus blocking them, and to prevent any water infiltration from a customer's leaking shut-off valve. Furthermore, special plugs shall be inserted so as to make visible any non-penetrating service connections in the lined pipe, and allow the operators to locate the non-penetrating service connections after they have been covered with the composite liner.
- (2) The Contractor shall plug the customer's service lateral and provide temporary water service to the customers.
- (3) Upon completion of the installation of liner and pressure testing, the Contractor shall re-open the existing service laterals to the customers from within the pipeline using robotic equipment. Water tightness at the service laterals must be maintained by the adherence of the liner to the existing pipe and the presence of epoxy around the threads of the corporation stop. Modifying the existing lateral by removing the protruding end and/or installing anything into the lateral that will remain as a permanent restriction or reduce the interior diameter of the existing service lateral is not allowed.

(N) EQUIPMENT SPECIFICATION

The Contractor shall use equipment which is recommended and approved by the cured-in-place-pipe liner manufacturer. A letter from the CIPP liner manufacturer approving the Contractor's equipment shall be provided to the Owner or Owner's Engineer prior to the start of CIPP installation.

The Contractor shall provide suitable temperature and pressure gauges in accordance with the manufacturer's standards and specifications. Puller unit/winch cable shall be equipped with manufacturer recommended tension gauge and shall be smooth running and variable speed. The cutting device shall be a remote monitored device for use inside the lined pipe.

The Contractor shall prepare and inspect all necessary tools and any spare parts that are required for equipment that suffer frequent breakdowns, and shall ensure that said tools and spare parts are available at the site. The Contractor shall also prepare and make operable all necessary communication equipment for his field crew.

(O) INSTALLATION OF LINER

Prior to the installation of liner, the Contractor shall fully comply with **Subsections (2) (C) through (2) (N)**, inclusively, and with any additional requirements set forth in the specific provisions applicable to the respective lining method. The Contractor shall not proceed with the installation of liner until the Engineer, in writing, certifies such compliance and directs the Contractor to proceed with the lining installation. The approved liner shall be installed pursuant to the specific provisions set forth for the lining method

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(P) PRESSURE TESTING

After installation and curing of the liner, the newly lined existing water main shall be pressure tested as per **ASTM F1743 Section 8.3.**

(Q) PRELIMINARY TELEVISION INSPECTION OF INSTALLED LINER

After the liner is sufficiently cool (below one hundred degrees Fahrenheit (100°F)) and before opening the service laterals, a preliminary television inspection and video recording of the newly installed liner shall be performed to determine if the liner is properly installed. If no services are involved then this will become the final TV inspection. (Sect S)

(R) SERVICE CONNECTIONS

After the pressure testing is completed, the Contractor shall re-open all existing service connections as ordered by the Engineer. These service connections shall be re-opened and paid for consistent with **Subsection (6).**

The proposed technology must allow for the re-opening of service connections without excavation and from the interior of the newly installed liner by the use of a remote controlled cutting device. At no point in this operation shall the adherence of the liner to the host pipe be compromised. A closed circuit television system shall be used for monitoring the operation. All connections that are to be re-opened shall be satisfactorily opened to the size of the original opening, and to the depth required to completely open the water service connection to the customer. Opening shall be smooth and flush.

(S) FINAL TELEVISION INSPECTION AFTER INSTALLATION

A final television inspection and video recording of the newly lined water main including the restored service connections shall be performed immediately after work is completed. Should the results of this final inspection reveal any defects that are determined by the Engineer to be repairable the Contractor will be required to repair these defects as ordered by the Engineer at the sole expense of the Contractor.

Payment for this final television inspection will be made under the contract bid item labeled "Television Inspection and Video Tape Recording."

(T) PIPELINE RE-ASSEMBLY

After final television inspection is completed the removed sections of the existing pipeline (e.g. at insertion/reception pits, valves, connections, etc.) shall be reconstructed in accordance with the contract plans and specifications and/or as ordered by the Engineer. No internal mechanical end seals shall be used to seal the extremities of the liner. The necessary end pieces shall be installed so as to make proper connection to the cut and lined existing water main pipe.

(U) DISINFECTION/CHLORINATION

Once all pipe work is completed to the satisfaction of the Engineer, the Contractor shall perform, as required, chlorine disinfection of the newly installed liner in accordance with the specifications and/or as ordered by the Engineer.

(V) RECOMMISSIONING

Recommissioning of water main shall be done in accordance with AWWA Standards or as ordered by the Engineer. Customer service shall be restored after acceptable samples have been obtained and approved by the Engineer.

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(W) WORK SCHEDULE

The Contractor is notified that the time for completion of work as specified in Schedule "A" of the specifications is provided for the total execution of the work under this contract. All work to be performed at the site of installation of cured-in-place-pipe liner work, including cleaning, television inspections, temporary water service, all necessary excavation and restoration, complete installation of the liner, reconnection of all service connections, reconnections, restoration of all disturbed pavement areas and all incidental work necessary and required to complete the work as specified, shall be conducted pursuant to these specifications and shall be completed within that time period.

During the time specified for work, the Contractor shall be permitted to occupy the lane immediately above the water main location and the parking lane immediately adjacent to the site of work unless otherwise specified. Unless otherwise specified in the traffic stipulations, no further roadway or traffic restrictions shall be permitted.

(3) INSTALLATION

(A) PREPARING AND INSERTING THE LINER

The Contractor shall designate a location, on job site, where the uncured resin in the original containers and the unimpregnated liner will be impregnated prior to installation. The Contractor shall allow the Engineer and/or his representative to inspect the materials and chemical impregnation "wet out" procedure. A resin and catalyst system recommended by the liner manufacturer and approved by the Engineer shall be used. The quantities of the liquid thermosetting materials inserted into the lining tube shall be as per manufacturer's standards so as to fully saturate the liner material and provide the lining thickness specified.

Immediately after cutting and prior to installation of liner, the ends of the adjacent existing water main that are not to be lined at the insertion/extraction points shall be covered/plugged so that no debris shall enter into them during reconstruction work.

The chemical impregnated liner material shall be inserted into the water main being reconstructed through the insertion point by either the direct inversion method or by the pull-in-place method, as recommended by the manufacturer. The head used to extend the liner tube shall be sufficient enough to fully extend the tube both circumferentially and longitudinally. The shaping of the liner may be achieved by pushing a pig through the hose using water pressure. The head used will fall within the manufacturer's guidelines to insure that a proper finished thickness is achieved and that the liner fit snug to the existing pipe wall producing dimples and/or at service connections and flared ends at the entrance and exit points.

Inflation of liners used shall be accomplished in accordance with manufacturer's standards and specifications. However, only circulating hot water shall be used as a heat source to cure the resin into a hard impermeable pipe. Use of hot air or circulating steam shall not be permitted during installation process.

(B) CURING OF LINER

After inflation or inversion is completed, the Contractor shall supply a hot water heat source. The equipment shall be capable of delivering hot water to the far end of the liner to uniformly raise the temperature in the entire liner above the temperature required to initiate and effect curing of the resin system. The temperature shall be determined by the resin/catalyst system employed. The heat source shall be fitted with suitable monitors to gauge the temperature and pressure of the incoming and outgoing heat exchanger circulating heating medium. Thermocouples or temperature gauges or infra-red gun shall be used at insertion and extraction points so as to determine and record the temperature of the liner and time of exotherm.

Initial cure shall be deemed to be completed when inspection of the exposed portions of the liner show it to be hard and sound; and when temperature reading(s) at the interface of the liner with the host pipe indicate sufficient heating has occurred. The cure period shall be of a duration recommended by the resin manufacturer; modified for the site specific conditions at the time curing is effected. During this cure time, the temperature inside the liner will be continuously maintained in the range required.

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Once the cure is complete, the Contractor shall cool the hardened liner to a temperature below one hundred degrees Fahrenheit (100°F) before relieving the internal pressure. Cool down shall be accomplished as recommended by the manufacturers. Care shall be taken in the release of the internal pressure so that a vacuum will not develop that could damage the newly installed liner.

The finished lining shall be continuous over the entire length and be free from visual defects such as foreign inclusions, dry spots, pinholes and delaminations. The lining shall be impervious and free of any leakage from the pipe to the surrounding ground or from the ground to the inside of the lined pipe.

If at the insertion/extraction ends the lining fails to make a tight seal, the Contractor shall apply a seal of a resin mixture compatible with the liner.

(4) MEASUREMENT

The quantity of reconstructed existing water main using cured-in-place-pipe liner to be measured for payment shall be the number of linear feet of existing water main actually reconstructed by a cured-in-place-pipe lining method, complete, all in accordance with the contract drawings and specifications and to the satisfaction of the Engineer, measured along the centerline of the water main from insertion point to extraction point.

(5) PRICE TO COVER

The contract price for Reconstruction of Existing Water Main Using Cured-In-Place Lining Method shall be the unit price bid per linear foot for the size water main reconstructed by a cured-in-place-pipe lining method and shall cover the cost of all labor, materials, plant, equipment, samples, tests and insurance required and necessary for the designing, fabricating, furnishing, delivering, cleaning, inspecting/surveying, installing, testing, reconnecting, disinfecting, and recommissioning of the existing water main reconstructed by using a cured-in-place-pipe liner method and do all work incidental thereto, all in accordance with the contract drawings and specifications and as directed by the Engineer.

Included in the price bid hereunder shall be the cost of all labor, material and equipment required to locate, excavate and setup insertion and receiving pits (including saw cutting and removal of the existing pavements, earth excavation of all materials of whatever nature encountered (See **Section 4.03 – EARTH EXCAVATION** of the Standard Sewer Specifications); sheeting and bracing; pumping; bridging; carefully hand excavating if required, removal of existing pipe, backfilling and compaction, cleaning up, disposal of surplus and rejected excavated materials, etc.), and cut/remove portion of water main at insertion and extraction points.

Also included in the price hereunder shall be the cost of any temporary water service provided to the customers.

In addition, included in the price hereunder shall be the cost for all television inspection and video tape recording required herein. No separate or additional payment will be made for this work.

(6) SEPARATE PAYMENT

Payment for re-opening of house water service connections shall be made under the contract bid item labeled "Re-Opening of Service Connection."

Payment for reconstructing the removed portions of existing water main so as to provide access for cured-in-place-pipe lining process at the insertion/extraction pits shall be made under the prices bid for the appropriate water main items.