

ITEM XII - CURED-IN-PLACE PIPE (CIPP)

12.01 SCOPE OF WORK

- A. This specification consists of the method and process for furnishing all labor, materials, tools, equipment and incidents necessary to provide complete rehabilitation of gravity sanitary sewers by installation of a thermo setting, polyester or epoxy vinyl ester resin, vacuum impregnated flexible polyester fill tube having an impermeable inner surface.
- B. Sewers to be rehabilitated, tested and sealed under this process are shown on the plans.
- C. All necessary bypass pumping, including appurtenances necessary to maintain sewer service is also part of the work specified under this Section.

D. Qualification

1. Contractor

All work shall be performed by a qualified contractor using cured-in-place piping from a qualified manufacturer. The qualified contractor shall be a licensed contractor of the qualified manufacturer. In order to qualify for the project, contractors shall have successfully installed a minimum of 50,000 lineal feet of similar sized cured-in-place pipe. Any contractors wishing to qualify shall submit a qualification submittal to the Engineer. Submittals must be received with the bid package.

The qualification submittal shall include the Contractor's name with a contact person, license number, address, phone number, fax number, description of previous projects totaling a minimum of 50,000 lineal feet of similar sized pipe, and at least three (3) references who are familiar with the cured-in-place process and the quality of the Contractor's work. A contact person and phone number shall be provided for each reference.

Prime Contractors that have been pre-qualified on previous cured-in-place lining projects shall not be required to resubmit qualification documentation for this project.

2. Manufacturer

Any manufacturer wishing to qualify shall have successfully had 100,000 lineal feet of similar sized cured-in-place pipe installed. The manufacturer shall have a minimum of three (3) years experience in the installation of cured-in-place pipe. Any manufacturers wishing to qualify shall submit a qualification submittal to the Engineer with the bid package.

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The qualification submittal shall include the Manufacturer’s name, address, phone number, fax number, description of previous projects totaling a minimum of 100,000 lineal feet of similar sized pipe, number of years with experience in the installation of cured-in-place pipe, and at least three (3) references who are familiar with the cured-in-place process and the quality of the Manufacturer’s product. A contact person and phone number shall be provided for each reference. The manufacturer shall also submit general information about the product, including documentation that the product meets applicable ASTM standards, and any other information that would help the Engineer determine the qualification of the manufacturer.

Manufacturers that have been pre-qualified on previous cured-in-place lining projects shall not be required to resubmit qualification documentation for this project.

12.02 SYSTEM DESCRIPTION

- A. The CIPP when cured shall have the following values when tested in accordance with ASTM F 1216:

<u>Physical Characteristic</u>	<u>Minimum Values</u>	<u>Test Method</u>
Flexural Strength.....	4,500 psi.....	ASTM D790 mod.
Modulus of Elasticity.....	250,000 psi.....	ASTM D790 mod.
Tensile Strength.....	3,000 psi.....	ASTM D638
Chemical Resistance	Loss not to..... exceed the above values	ASTM D453

- B. The existing host pipe shall be considered **fully deteriorated** for design calculations.
- C. Contractor shall confirm loadings on buried pipe based on depths, soil conditions and water table. The height of water table shall be the same as the depth of soil above the pipe. The design soil unit weight shall be 120 pounds per cubic foot. The pipe shall also be designed for an additional AASHTO HS-20 highway live load condition.
- D. All pipes shall be designed with a minimum of 2% ovality in the circumference. Any deviation must be approved by the Engineer.
- E. Thickness of CIPP shall be rounded to the next higher multiple of 1.5 mm, after adding an allowance of 5% to the design thickness for resin migration per manufacturer recommendation.

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E. The minimum CIPP design thickness shall meet the requirements of equations XI.1, XI.2, XI.3, and XI.4 in the appendixes of ASTM F 1216.

G. The following values shall be used in submitted design calculations:

Initial Flexural Modulus	=	250,000 psi
Long-Term CIPP Creep	=	50%
Overall Safety Factor	=	2.0
Soil Height	=	maximum project soil height
Modulus of Soil Reaction	=	700 psi
Ground Water Height	=	maximum project soil height
Bending Stress Safety Factor	=	2.0
Initial Flexural strength	=	4500 psi
Resin Seal Factor	=	5%
Pipe ovality or Deflection (as a %)	=	2.0%
Long-Term Flexural Modulus	=	125,000 psi
Long-Term Flexural Strength	=	2,250 psi
Water Buoyancy Factor	=	0.67 minimum

Values not listed in this specification shall be approved by the Engineer prior to submittal of design calculations.

H. **The minimum acceptable installed liner thickness for a 6” diameter shall be 4.5 mm. The minimum acceptable installed liner thickness for an 8” diameter shall be 6.0 mm. The final liner thickness shall not include non-structural thickness of calibration tubes.**

12.03 QUALITY ASSURANCE

- A. The materials and the method of installation shall be in accordance with ASTM standards and in accordance with manufacturers recommendations.
- B. The Contractor shall test all sewers, service line connections and piping reconstructed under this Contract.
- C. All testing shall be done by the Contractor or an independent testing firm approved by the Engineer.

12.04 REFERENCES

- A. Codes, specifications, and standards, referred to by number or title, shall form a part of this specification to the extent required by the reference thereto. Latest revision shall apply in all cases.

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1. Following is a partial list of American Society of Testing & Materials which are applicable to this specification.
 - a. **ASTM-F1216-93** Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the inversion and Curing of a Resin-Impregnated Tube
 - b. **ASTM-F1743-96** Standard Practice for Rehabilitation of Existing Pipelines and Conduits by Pulled-in-Place Installation of Cured-In-Place Thermo Setting Resin Pipe (CIPP)
 - c. **ASTM-D-5813-95** Standard Specification for Cured-In-Place Thermosetting Resin Sewer Pipe
 - d. **ASTM-D-790-00** Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
 - e. **ASTM-D-638-01** Standard Test Method for Tensile Properties of Plastics

12.05 SUBMITTALS

A. SHOP DRAWINGS

The Contractor shall submit at least five (5) copies of shop drawings to the Engineer for approval. The shop drawings shall include the items listed below:

1. Contractor's Stamp verifying Contractor's approval on each shop drawing. Shop drawings shall not be approved without a Contractor's stamp.
2. The design installed wall thickness of CIPP to be rehabilitated as recommended by manufacturer. Design calculations used to determine wall thickness shall be provided. The liner thickness shall be approved by the Engineer prior to liner manufacture or installation.
3. Data on resin and recommended curing cycle to Engineer for approval.
4. Proposed installation method.

B. PRE-CONSTRUCTION VIDEO

1. Provide two (2) copies of tapes of the video inspection performed no longer than 24 hours prior to installation of the CIPP. Videotapes shall include voice description, as appropriate, with stationing of services indicated. Data and stationing to be on videotapes. Videotapes shall begin at Station 0.0 Ft. TV codes shall conform to the City of Cayce Sewer Condition Classification Manual, latest edition.

C. POST CONSTRUCTION SUBMITTALS

1. Provide two (2) copies of videotapes of sewer after installation of CIPP. Video tapes shall include voice description as appropriate with stationing of

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services indicated. Data and stationing to be on videotapes. Videotapes shall begin at Station 0.0 ft. TV codes shall conform to the City of Cayce Sewer Condition Classification Manual, latest edition.

2. Provide one (1) copy of multiple CD's containing one MPV file for each post TV inspection of the liner from manhole to manhole. The CD's may be filled to capacity with as many MPV files that will fit on a CD. Each MPV file will be labeled with corresponding manhole numbers of the line segment inspected. For example, a file containing TV information of a liner inspected from manhole 28000 to manhole 28001 would be labeled "28000-28001.MPV".
3. Certified copies of all test reports on the properties of the selected resin and later, on the field liner samples, performed by an approved independent testing company, shall be submitted to the Engineer.

12.06 PRODUCT HANDLING

1. The Contractor shall use all means necessary to protect sewer line materials before, during, and after installation and to protect the installed work and materials of other trades. In the event of damage, the Contractor shall immediately make all repairs and replacements necessary to the approval of the Engineer, at no additional cost to the Owner.

12.07 SITE CONDITIONS

- A. The Contractor shall satisfy himself of the condition of the sewer sections or pipeline to be lined. The Contractor shall be responsible for verifying the size and condition of the existing sewer and his ability to insert the CIPP liner, prior to ordering materials, by TV inspection and shall not receive compensation for excavations to remove obstructions due to conditions of which he could have informed himself.
- B. Prior to entering access areas such as manholes or inspection hatches and performing inspection or cleaning operation, an evaluation of the atmosphere to determine the presence of toxic, flammable vapors or lack of oxygen must be undertaken by the Contractor in accordance with local, state and federal OSHA safety regulations.
- C. TELEVISION INSPECTION
 1. No longer than 24 hours prior to installation, all sewer sections and pressure pipelines which are to receive the CIPP are to be inspected by closed circuit television to confirm any changes that may have occurred from the date of the original inspection. All sewers or pipelines are to be cleaned as stated below prior to the television inspection.

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2. The television inspection shall be performed in order to supply a visual and audio record of the location of obstructions in the sewer that would interfere with or prohibit lining of the sewer and provide the location of service laterals that are to be reconnected to the new CIPP. A color television inspection camera with pan and tilt capability is required for all inspections.
3. Videotapes, CD's, and hard copy reports shall be made for each line inspected. The quality of the tapes shall be such that obstructions and service lateral locations are clearly identified and can be located. The Contractor shall make the tapes, CD's, and reports available to the Owner for review. Areas in the pipe where camera is underwater shall be cleared of debris prior to or during inspection to allow complete survey of pipe. Post construction video with “camera underwater” conditions due to debris will not be accepted.
4. If there is an obstruction in the sewer line that will not allow the television camera to pass, then the camera shall be backed out of the line and an attempt shall be made to televise the line from the manhole at the other end. If the entire length of the sewer line cannot be televised because of two or more obstructions, then the Engineer shall be notified and a determination of how to proceed shall be made by the Engineer.
5. The Contractor shall provide a videotape and CD of the finished CIPP after accepted by the Owner.
6. The cost of the television inspection, videotapes, CD's, and reports shall be included in the unit cost of the CIPP.
7. The City of Cayce intends to perform an additional video inspection of the lines prior to the expiration of the one (1) year warranty.

12.08 WARRANTY

The manufacturer shall warrant all materials to be free from defects in workmanship and materials for a period of one (1) year after final acceptance.

12.09 MATERIALS

A. TUBE

1. The tube should consist of two or more layers of flexible needled felt or an equivalent nonwoven material capable of: carrying resin, withstanding installation pressure, installation tension (if pulled in place) and curing

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temperatures, and should be compatible with the resin system recommended by the manufacturer.

2. The material shall be able to stretch to fit irregular pipe sections and negotiate bends.
3. The tube shall be fabricated to a size that, when installed, will tightly fit the internal circumference and the length of the original sewer or pipe.
4. Allowance shall be made for circumferential stretching during installation.
5. The fabric tube and seam (if applicable) shall be tested in accordance with Test Method D1682. The tube shall have a minimum tensile strength of 750 psi in both the longitudinal and transverse directions.

B. RESIN

1. The resin system shall be a corrosion resistant polyester, vinyl ester, or epoxy and catalyst system that meets the requirements of ASTM F1216 and the physical properties herein.

12.10 SURFACE PREPARATION

- A. All sewer sections that are to receive the CIPP are to be thoroughly cleaned and all debris, roots and other obstructions removed. All material removed from the existing sewer sections shall be properly transported to an approved disposal site obtained by the Contractor on a daily basis. Under no circumstances will the Contractor be allowed to accumulate debris or to create a public nuisance.
- B. The method used to clean the sewer sections shall be at the option of the Contractor and may include high pressure water jet cleaning, brushes, balls, swabs, bucket machine or other methods. The Contractor shall be responsible for damage to the sewer sections due to improper cleaning methods.
- C. The cost of preparatory cleaning shall be included in the unit price of the CIPP.
- D. **REMOVAL OF OBSTRUCTIONS IN SEWER**
 1. Obstructions in the sewer sections which cannot be dislodged or cleared by cleaning, bucketing, dragging a mandrel, or other internal methods shall be cleared by excavation. The Contractor shall notify the Engineer prior to any excavation work that is performed that is not indicated on the plans.
 2. The excavation shall conform to requirements of Section VI-1, “Excavation,” and shall be located to minimize the obstruction of traffic

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where possible. The size of the excavation shall be kept to a minimum and shall be shored and sheeted as required.

3. The existing sewers shall be repaired, after the obstruction is removed, in accordance with MSD Standards.
4. If more than two obstructions require excavation in any one sewer section, the Contractor shall notify the Engineer and a determination of how to proceed shall be made by the Engineer.

12.11 FIELD MEASUREMENTS

The Contractor shall make all necessary measurements in the field to ensure precise fit of items in accordance with the drawings. In the event of a discrepancy, the Contractor shall immediately notify the Engineer. The Contractor shall not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

12.12 INSPECTION OF PIPE LINER

Each pipe liner shall be subject to inspection by the Engineer immediately before it is installed. Defective liner or undersized tube thickness liner will be rejected for use on the project.

12.13 INSTALLATION

A. INSERTION OF CURED-IN-PLACE PIPE

1. The Contractor shall make every effort to maintain service usage throughout the duration of the project. In the event that a service will be temporarily out of service, the maximum amount of time of no service shall be 8 hours for any property served by the sewer. The Contractor shall be required to notify the Owner and all affected properties whose service laterals will be out of commission and to advise against water usage until the sewer main is back in service. Such notifications shall be provided to Owner at least one week prior to service disconnecting.
2. The Contractor shall provide for continuous sewage flow around the sections(s) of pipe designated for insertion of liners, when required for acceptable completion of an insertion process. The pump and bypass line shall be of adequate capacity and size to handle the flow.
3. The Contractor shall designate a location where the felt tube will be impregnated (“wetted out”) with resin using distribution rollers and vacuum, to thoroughly saturate the felt tube prior to its dispatch for installation. The Contractor shall inform the Engineer in advance to inspect the materials and the wet out procedure. A catalyst system or additive(s) compatible with the

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resin and tube may be used as per the manufacturer's recommendation. They shall, however, not impair or reduce the resin's quality to withstand the minimum chemical resistance criteria.

4. The wetted out tube shall be transported and kept in a refrigerated truck until it is inserted through an existing manhole by approved techniques/process of the installer or the Contractor. The insertion area, equipment platform, etc., shall be securely protected, and all damaged yards, driveways, walks, etc., shall be repaired at no cost to the Owner.
5. The liner may be installed by inversion method per ASTM F1216 or by the pulled-in-place method per ASTM F1743.
6. Water inversion shall be accomplished by using natural water pressure (head) only. Natural water pressure shall be achieved by erecting platforms or scaffolding to an elevation determined by the Contractor necessary to provide adequate inversion heads (pressures). CIPP installation vessels/units used to create water pressure shall not be used. Water pressure shall not be varied by any means throughout the inversion process except by increasing the height of the platform/scaffolding. The Contractor shall submit required inversion heads for each installation, as a shop drawing without delay and claim to confidentiality of product/installation privacy.
7. After the insertion is completed, the Contractor shall use a hot water recirculation system, capable of delivering desired heat uniformly throughout the section, for a consistent cure of the resin. All water used shall be from metered supply and paid for to the Water System Owner through the regular billing system. The curing temperatures shall be recommended by the resin/catalyst system of the resin manufacturer. The heat source shall be fitted with suitable monitors to gauge the temperature of the incoming and outgoing heat source. Another such gauge shall be placed between the impregnated tube and the invert to the original pipe at the manhole(s) to determine the temperatures during the resin curing process. Initial cure may be considered completed when the exposed portions of the felt tube pipe appear to be hard, and the remote sensing device indicates the temperatures to be adequate, as recommended by the resin/catalyst system manufacturer, and approved by the Engineer. Curing temperatures and duration shall comply with previously submitted data and information.
8. The Contractor shall cool the hardened pipe to a temperature below 100°F before relieving the water column. Cool water may be added to the water column while draining hot water from a small hole at the opposite end of the CIPP, so that a constant water column height is maintained until cool-down is completed. Care shall be taken in the release of the water column so that a vacuum will not be developed that could damage the newly installed pipe. Liner samples shall be obtained for testing at this time. Cool

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down process may vary depending on the installation technique of the manufacturer/contractor.

9. The finished CIPP shall be continuous over the entire length from manhole to manhole and be free from visual defects such as foreign inclusions, dry spots, keel, boat hull, pinholes, wrinkles and other deformities. The liner passing through or terminating in a manhole shall be carefully cut out (also for samples) in a shape and manner approved by the Engineer. The invert and benches shall be streamlined and improved for smooth flow. The area/annular space between existing and the CIPP shall be sealed with approved materials in an approved manner described within the specifications. It shall also meet the leakage requirements of pressure test as specified. During the warranty period, which shall be defined as twelve (12) calendar months after final acceptance by the Owner, any defect which will affect the integrity or strength of the pipe or impede the flow through the pipe shall be repaired at the Contractor's expense, in a manner mutually agreed to by the Owner, Engineer and the Contractor.

B. SEALING AND BENCHES IN MANHOLE

1. The CIPP shall make a tight fitting seal with the existing pipe(s) in the manhole. 1/2" diameter activated oakum band soaked in Scotch Seal 5600 or equal, shall be applied circumferentially near the annular space touching the end of existing pipe and encased with a cementitious mortar. Top half of the pipe shall be neatly cut off and not broken or sheared off, at least 4" away from the walls and a pipe collar built over pipe. The channel in the manhole shall be smooth continuation of the pipe(s) and shall be merged with other lines or channels, if any. Channel cross-section shall be U-shaped with a minimum height of 6" for 8" pipe and full depth for greater sized pipes. The side of the channels shall be built up with mortar/concrete to provide benches at a 1 in 12 pitch toward the channel. All grout work including invert bench and pipe collars are to have a steel trowel finish.
2. Payment for above work shall be incidental to sewer rehabilitation by the CIPP method, since that payment is made from centerline to centerline of manhole(s), be that the end of the liner.
3. The CIPP and the existing pipe in the manhole must be sealed as above before proceeding on to the next manhole section, and all manholes shall be individually inspected for liner cut-offs, benches and sealing works.

C. SERVICE / OUTSIDE DROP RECONNECTIONS

1. After the pipe liner has been formed in place, the Contractor shall reconnect the existing active service connections as designated by the Engineer. This shall be done without excavation unless otherwise directed by the Engineer,

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from the interior of the pipeline by means of a television camera and a cutting device that re-establishes the service connections to not less than 90 percent capacity.

2. The exact location and number of service connections shall be determined from TV tapes and/or in the field. It shall be the Contractor's responsibility to accurately field locate all existing service connections whether in service or not. *The Contractor shall reconnect all active service connections to the liner pipe, unless directed otherwise by the Engineer.* The Contractor shall be responsible for restoring/correcting without any delay, all missed or faulty reconnections, as well as for any damage caused to property owners for not reconnecting the services soon enough or for not giving notice to the Owners. All services which are reconnected to rehabilitated liner shall be shown on the "Record Drawings" with the exact distance from the nearest upstream/downstream manhole.
4. All existing service connections shall be reconnected by Remote TV Controlled Cutting Device method. In the event that the remote cut does not meet the Engineer's approval with respect to quality and workmanship, the service connection shall be performed by excavation at no additional cost to the Owner.
4. The Engineer may direct the Contractor to replace the service lateral from the main line to the clean-out assembly (See No. 6 of this section).
5. Service Connection by Remote Cut
 - a. All service connections shall be done by TV controlled Remote Cutting Device unless otherwise directed by the engineer. These shall be made by experienced operators so that no blind attempt or holes are made in the liner pipe. Location shall be re-verified carefully with earlier tapes for accuracy, especially where dimples are not defined or clearly ascertained. The Engineer reserves the right to require service connection by excavation at certain or all locations at no additional cost to the Owner, if the quality, workmanship and approval rating for remote cut is poor and not satisfactory.
 - b. The remote cut shall be smooth and circular in nature as seen by a 360° TV camera. The hole shall be a maximum of 100% and a minimum of 90% of the service pipe diameter. It shall be properly aligned and be concentric to the existing connection. The locations of all remote cuts shall be verified carefully to match with earlier tapes for their exact locations. Excess, wrong holes or trial cuts shall not be made and must be repaired at no cost to the Owner to the full satisfaction of the Engineer. The Engineer may check the completed

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remote connections for the minimum 90% requirement by excavating the site, in which case payment shall be made for the excavation at the location and for any special backfill, if necessary. Defective connections shall be repaired to the Engineer's satisfaction at no extra cost.

- c. Protruding taps that will obstruct or hinder the insertion of the liner, shall be removed to allow the liner to pass through. If these taps are to be reinstated at a later time by excavation, the initial removal will be incidental. If the camera equipment cannot pass, the trimming will be paid as a removal of protruding service by remote cut upon approval by Engineer.
- d. Outside drop pipes at drop manholes shall be reconnected by remote cut. Payment for this reconnection shall be the same as for a service connection by remote cut.

6. Service Connection by Excavation

- a. In the event of poor quality or workmanship of the remote cut, or if service lateral replacement is directed by the Engineer, the existing service connections may be done by Excavation method with the Engineer's approval. The existing sewer (now the carrier or host pipe for the liner) shall be carefully broken/removed to expose the liner to the extent necessary. The liner pipe shall not be damaged and shall be allowed to normalize to ambient temperature and cool down, before a 4" or 6" diameter hole is cored out with a hole saw. This coupon shall be retrieved and handed over to the Engineer for inspection of the liner thickness at that location, if so required. The size of new service shall match the existing service size.
- b. A three piece service connection shall be installed consisting of an IPS/Schedule 40 PVC hub, rubber sleeve and 301 stainless steel band. The service connection shall be a compression fitting such as INSERTA TEE as manufactured by Inserta Fittings Company or equal for 8" and larger mains. The rubber sleeve shall meet ASTM C443. The PVC hub gasket shall meet ASTM F477.
- c. The rubber sleeve shall be lubricated as recommended by the manufacturer. The rubber sleeve shall be inserted into the pipe liner such that the entry lip forms a complete seal between the inside of the pipe liner and the sleeve entry lip. The PVC hub shall be inserted into the rubber sleeve to the mark shown on the outside of the hub. The hub shall not protrude into the pipe liner such that a TV camera cannot pass.

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- d. Place the stainless band around the top of the rubber sleeve and tighten down. Install lateral service pipe in the normal manner.
- e. If directed by the Engineer, the contractor shall replace the existing service line to the clean-out assembly.
- f. One or more homes discharging into a common connection shall be considered as one service connection. Damage repair to residences or properties due to delay or faulty connections shall be incidental.
- g. Compression fittings shall not be used on 6" main lines. Saddles shall be used for 6" lines as shown on the plans.

D. TESTING

A sample shall be cut from a section of cured CIPP at the installed liner termination point, that has been inverted through a like diameter pipe which has been held in place by a suitable heat sink, such as sandbags. Each sample shall be large enough to provide a minimum of three specimens and a recommended five specimens for flexural testing.

Thickness measurements, flexural stress, flexural modulus of elasticity, and tensile tests shall be performed for each sample. Eight thickness measurements shall be made per ASTM D2122 and the average thickness shall be the determined sample thickness. The minimum wall thickness at any point shall not be less than 87.5% of the specified thickness.

Five specimens of each sample shall be tested for flexural stress and flexural modulus of elasticity per ASTM D790. The dimensions of each specimen including width, depth, and span shall be reported. Data items shall be reported for each of five specimens tested as follows:

Specimen Number
Displacement at Yield (in)
Strain at Yield (in / in)
Load at Yield (lbs.)
Stress at Yield (psi)
Modulus of Elasticity (psi)

The mean, standard deviation, minimum value, and maximum value for the group of specimens shall be reported for each data item.

Each report shall contain sample identification information for each sample including project name, sample number, date sample received, date sample tested, diameter of liner sample, upstream manhole number and downstream manhole number where sample taken.

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Sample conditioning information such as humidity and temperature shall be provided on each report. Sample reports submitted to the Engineer without the specified data shall be rejected. The sample report, *which is included at the end of this section*, shall be used as a guide for this project.

Tensile tests shall be performed per ASTM-D-638-01.

12.14 SERVICE LATERAL REHABILITATION

- A. For all service connections that do not currently have a clean-out assembly installed at the edge of the road right-of-way or prescriptive right-of-way, the Contractor shall install a clean-out assembly on the existing service lateral. Laterals to have clean-outs installed shall be approved by the Engineer's field representative prior to installation.

Clean-out assemblies shall be installed in accordance with Owner's standard details and technical specifications.

- B. In addition to the television inspection that will be required prior to installation of the cured-in-place pipe, all service laterals shall be inspected. The method of televising service laterals may be chosen by the Contractor, but must be coordinated and approved by the Engineer prior to inspection of the laterals.

The Contractor shall coordinate each service lateral inspection with the Engineer's field representative. At the time of the inspection, the field representative shall make a decision whether to replace the lateral or not. The field representative may determine that replacement of the lateral is not required.

- C. If it is determined that the lateral needs to be replaced, the Contractor shall replace the existing service line from the clean-out to the main collection system line by means of open-cut excavation. Service laterals shall be constructed in accordance with Owner's standard details, the Special Conditions (Section V), and Section VI – II of the Technical Specifications.

12.15 FIELD QUALITY CONTROL

- A. The manufacturer of the CIPP material shall provide technical and installation advice to the Contractor work force when first installing the CIPP. The service of an experienced installation representative shall be provided for a minimum of two days at no additional cost to the Owner.
- B. Video tapes shall be required after the liner has been installed in the existing sewer pipe, at no additional cost to the Owner. The televising shall be done after all service connections have been made, unless required earlier by the Engineer.

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- C. A smoke test shall be performed on all service line connections made by open excavation that are constructed due to poor quality or workmanship of the remote cut, at no extra cost to the Owner. No excavated taps shall be backfilled until completion of this test. The Contractor shall isolate the manhole section to be tested from the adjacent manhole sections to prevent smoke from migrating into lines not being tested, as well as to provide a concentration of smoke in the section being tested.
- D. All smoke testing shall be closely coordinated with and scheduled through the Owner. Before smoke testing, written notice(s) shall be given to the area residents not fewer than two (2) days, nor more than seven (7) days, prior to the proposed testing. Notice shall also be given to the local Police Department and local Fire Station, twenty-four (24) hours prior to actual smoke testing. This test shall be conducted by forcing smoke from smoke generators, through the newly rehabilitated sanitary sewer main. The smoke generators shall have a minimum duration of five (5) minutes with a capacity of 1500-2000 cfm.
- E. Smoke shall be introduced as per the Manufacturer's recommendations. The Engineer, accompanied by the Contractor, shall check each service line connection being tested. Sources of all leaks must be found and noted for correction.
- F. All service line connections noted as leaking shall be repaired or replaced and then retested. The Contractor may be allowed to leave the service line connection exposed in one (1) manhole section at a time, to minimize inconvenience and hazard to the residents. If service line connection repair or replacement, testing or retesting, and backfilling of the excavation is not completed within the work day, the Contractor shall properly cover each excavation with steel plates, plywood, or some other approved material, to keep the area secure from accidents or hazard.
- G. In houses where smoke does not issue from the plumbing vent stacks to confirm the reconnection of the sewer service to the newly installed liner, a dye test may be required to confirm the reconnection. Dye shall be introduced into all service lines and then each line shall be flooded with water. The Contractor and the Engineer shall look to the downstream manhole to detect the dye coming out of the sewer main. This shall confirm a reconnection. If any more than one service connection is dye tested at a time, these dye tests shall be done with enough time allowed between each test to allow the dye to be purged from the line. Otherwise, different colored dyes shall be used. Dye testing shall be performed by the Contractor at no additional cost to the Owner.

12.16 POST TELEVISIONING OF COMPLETED SECTIONS

- A. The Contractor will provide to the Engineer a color video tape taken by a 360° radial view camera for close up view, showing the completed work, including the condition of the restored pipes prior to requesting payment.

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- B. Television inspection, tapes and report, etc., shall be as specified elsewhere in this section. Upon completion of the installation work and testing, the Contractor shall restore/clear the project area affected by his operations. No trash, rubbish etc., shall be stored at any site, be the work in progress or not.

12.17 CLEAN-UP

1. The contractor shall restore or replace all removed or damaged paving, curbing, sidewalks, gutters, shrubbery, fences, sod or other disturbed surfaces or structures in a condition equal to that before the work began, to the satisfaction of the Engineer, and shall furnish all labor and material incidental thereto.
2. Surplus liner material, tools and temporary structures shall be removed by the Contractor. All dirt, rubbish and excess earth from operation shall be legally disposed of by the Contractor, and the construction site shall be left clean, to the satisfaction of the Engineer.

12.18 PATENTS

The Contractor shall Warrant and save harmless the Owner against claims for patent infringement and any loss thereof.