2024
SANITARY SEWER REHABILITATION SPECIFICATIONS

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SECTION 1.00 - SCOPE

1.01 GENERAL

It is the intent of these specification requirements to provide the requirements for sanitary sewer rehabilitation work in the City of Chanhassen, Minnesota.

1.02 WORK INCLUDED

The contractor shall, unless specified otherwise, furnish all materials, equipment, tools and labor necessary to do the work required under his/her contract consisting of the trenchless pipe lining, spot repair, cleaning and joint testing and sealing of existing sanitary sewer mains. The sewer main spot repair work shall be performing utilizing plant fabricated pipe and other appurtenant materials installed for the conveyance of sewage. The trenchless pipe lining, testing and sealing, and cleaning work shall be performed using the specified procedures and also includes the rehabilitation of sanitary sewer manholes and other related items.

1.03 LOCATION OF WORK

The location of this work is as shown on the plans.

1.04 COORDINATION OF WORK

The contractor shall be responsible for the satisfactory coordination of the sanitary sewer rehabilitation with other construction and activities in the area affected. Delays in work resulting from lack of such harmony shall not in any way be a cause for extra compensation by any of the parties.

1.05 WORKING HOURS

Refer to Section 7.02 of the General Conditions.

SECTION 2.00 - SEWER LINE CLEANING

2.01 SEWER LINE CLEANING

Since the success of the other phases of rehabilitation depends a great deal on the cleanliness of the sewer lines, the importance of this phase of the operation is emphasized.

A. Cleaning Equipment

All sections of sewer main or service line to be air tested at joints and sealed shall be cleaned using an approved cleaning method. Selection of equipment shall be based on field conditions such as access to manholes, type and quantity of debris to be removed, physical condition of line, size of sewer, and depth of flow.

Hydraulically propelled equipment will be of the movable dam type and be constructed in such a way that a portion of the dam may be collapsed at any time during the cleaning operations to protect against flooding of the sewer. The movable dam will be equal in diameter to the pipe being cleaned and will provide a flexible scraper around the outer periphery to insure removal of grease. If sewer cleaning balls or other equipment which cannot be collapsed is used, special precautions to prevent flooding of the sewers and public or private property will be taken.

High-Velocity Jet (Hydro cleaning) equipment shall be constructed for ease of safety and operation. The equipment will have a selection of two (2) or more high-velocity nozzles. The nozzles will be capable of producing a scouring action from 15 to 45 degrees in all size lines designated to be cleaned. The equipment will include a high-velocity gun for washing and scouring manhole walls and floors. The gun will be capable of producing flows from a fin spray to a solid stream. The equipment will carry its own water tank, auxiliary engines, pumps and hydraulically driver hose reel.

Mechanically powered equipment such as bucket machines will be in pairs with sufficient power to perform the work in an efficient manner. Machines will be belt operated or have an overload device. Machines with direct drive that could cause damage to the pipeline are not permitted. A power rodding machine will be either a sectional or continuous rod type capable of holding a minimum of 750.0-feet of rod. The rod will be specifically heat-treated steel. The machine will be fully enclosed and have an automatic safety clutch or relief valve.

After cleaning, sanitary sewer and manholes shall be free of sludge, mud, sand, gravel, rock, grass, roots, or any other objects which may prevent the Contractor from properly testing and sealing joints. All material removed during the cleaning operations shall become the property of the Contractor. It shall be the Contractor’s responsibility to properly pay for and dispose of this material. The Contractor will be solely responsible for any damage caused to public infrastructure due to improper use or negligence of the Contractor when completing the documented cleaning procedures.

In this section of sewer main or service line which requires cleaning, testing, and sealing or spot repair work, payment for cleaning will be made for the LF of sewer main or service line actually worked on, including the portion(s) to be spot repaired.

B. Root Removal

Special attention should be used during the cleaning operation to assure the removal of all roots from the joints. Any roots which could prevent the proposed construction methods shall be removed. Payment for root removal shall be incidental to the contract unit price per lineal foot for sewer main or service line cleaning.

C. Protruding Tap Removal

The Contractor shall remove any protruding taps located in the sewer main prior to testing and sealing operations. Removal shall be accomplished by remote controlled saws or other methods as approved by the Engineer. Payment for removal of protruding taps shall be paid per item as shown on the bid tab, if no item is shown then it shall be considered as incidental to the contract unit price per lineal foot for sewer main cleaning.

D. Cleaning Precautions

During sewer cleaning operations, satisfactory precautions will be taken in the use of cleaning equipment. When hydraulically propelled cleaning tools or tools which retard the flow in the sewer lines are used, precautions will be taken to ensure that the water pressure created does not damage or cause flooding or public or private property being served by the sewer. The Contractor will be fully responsible for any property damage caused by the cleaning operations

SECTION 3.00 - SEWER FLOW CONTROL

3.01 SEWER FLOW CONTROL

When a sewer line depth of flow at the upstream manhole of the manhole section being worked is above the maximum allowable for television inspection, joint testing and/or sealing, the flow shall be reduced to the level shown below by operation of pump stations, plugging or blocking of flow, or by pumping and bypassing of the flow.

Maximum Depth of Flow	Television Inspection
6”-10” Pipe	20% of pipe diameter
12”-24” Pipe	25% of pipe diameter

Maximum Depth of Flow	Joint Testing/Sealing
6”-12” Pipe	25% of pipe diameter
12”-24” Pipe	30% of pipe diameter

A. Plugging

A sewer line plug may be installed upstream of the section being worked. The plug is always to be installed in the upstream (incoming) pipe of the manhole. The plug shall be so designed that all or any portion of the sewage can be released.

B. Pumping and Bypassing

When pumping and bypassing is required, the Contractor shall supply and operate the pumps, conduits, and other equipment (of sufficient capacity) to divert the flow of sewage around the manhole section in which work is to be performed. Under no circumstances will the dumping of raw sewage onto the ground and streets or into the storm sewer be allowed.

C. Precautions

When the flow in a sewer line is reduced, plugged, or bypassed, precautions must be taken to ensure that damage due to flooding does not result from these operations. The Contractor shall monitor sewer surcharging upstream of the manhole section being worked in to protect the sewer lines from unnecessary damage. Any damage shall be the responsibility of the Contractor.

SECTION 4.00 SEWER PIPE JOINT TEST AND SEAL

4.01 SEWER PIPE JOINT TESTING

The intent of sewer pipe joint testing is to test the integrity of individual pipe joints.

A. Test Medium

Both liquid (usually water) and air are acceptable, but the test procedure is different for each.

B. Equipment.

The basic equipment used shall consist of a television camera, joint testing device, and test monitoring equipment. The equipment shall be constructed in such a way as to provide means for introducing the test medium, under pressure, into the VOID area created by the expanded ends of the joint testing device. A means for continuously measuring the actual static pressure of the test medium and within the VOID area only shall also be provided. The pressure-metering device shall display pressure to within 1/2 of one psi.

VOID pressure data shall be transmitted electrically from the VOID to the monitoring equipment. Example: Via a TV picture of a pressure gauge located at the VOID, or via an electrical pressure transducer located at the VOID.

C. Test Pressure.

Joint test pressure must be higher than the groundwater pressure outside the pipe. A test pressure 2-4 psi higher than the groundwater pressure is recommended. In the absence of groundwater pressure data, the test pressure should be at least equal to 1/2 psi per vertical foot of pipe depth plus 2 psi (not exceeding 10 psi).

D. Liquid Test Procedure

1. The testing device shall be positioned within the line in such a manner as to straddle the pipe joint to be tested.

2. The testing device ends (end elements, sleeves) shall be expanded so as to isolate the joint from the remainder of the line and create a VOID area between the testing device and the pipe joint. The ends of the testing device shall be expanded against the pipe with sufficient pressure to contain a minimum of 10 psi within the VOID area without leakage past the expanded ends.

3. Water or an equivalent liquid shall then be introduced into the VOID area until a pressure equal to or greater than the required test pressure is observed with the VOID pressure monitoring equipment. If the required test pressure cannot be developed (due to joint leakage), the joint will have failed the test and shall be resealed.

4. The flow rate of the test liquid shall then be regulated to a rate at which the VOID pressure is observed to be the required test pressure. A reading of test liquid flow meter shall then be taken. If the flow rate exceeds 1/4 gallon per minute (due to joint leakage), the joint will have failed the test and shall be resealed.

E. Air Test Procedure

1. The testing device shall be positioned within the line in such a manner as to straddle the pipe joint to be tested.

2. The testing device ends (end elements, sleeves) shall be expanded so as to isolate the joint from remainder of the line and create a VOID area between the testing device and the pipe joint. The ends of the testing device shall be expanded against the pipe with sufficient pressure to contain a minimum of 10 psi within the VOID area without leakage past the expanded ends.

3. Air shall then be introduced into the VOID area until a pressure equal to or greater than the required test pressure is observed with the VOID area pressure monitoring equipment. If the required test pressure cannot be developed (due to joint leakage), the joint will have failed the test and shall be resealed.

4. After the VOID pressure is observed to be equal to or greater than the required test pressure, the airflow shall be stopped. If the VOID pressure decays by more than 1 psi within 30 seconds (due to joint leakage), the joint will have failed the test and shall be resealed.

F. Control Test. Prior to starting, the pipe joint testing phase of the work, a two-part control test, shall be performed as follows:

1. To ensure the accuracy, integrity, and performance capabilities of the testing equipment, a demonstration test is to be performed in a test cylinder constructed in such a manner that a minimum of two known leak sizes can be simulated.

This technique is to establish the test equipment performance capability in relationship to the test criteria and ensure that there is no leakage of the test medium from the system or other equipment defects that could affect the joint testing results. If this test cannot be performed successfully, the Contractor shall be instructed to repair or otherwise modify his/her equipment and re-perform the test until the results are satisfactory to the Engineer.

2. After entering each manhole section with the test equipment, but prior to the commencement of joint testing, the test equipment shall be positioned on a section of sound sewer pipe between pipe joints, and a test performed as specified. This procedure is to demonstrate the reality of the test requirement, as no joint does test in excess of the pipe barrel capability. Should it be found that the barrel of the sewer pipe does not meet the joint test requirements, the test requirements will be modified by the Engineer.

3. Set Up: All work required to set up joint testing and sealing equipment in the required manholes shall be incidental to the joint testing and sealing work with no separate compensation given.

4.02 SEWER PIPE JOINT SEALING

It is the intent of the sewer pipe joint sealing work to seal sewer pipe joints which have been indicated to be a source of infiltration into the system, utilizing the internal joint sealing method. It is realized that this method may only be used on sewer pipe sections that are clean and in sound physical condition.

A. Equipment.

The basic equipment shall consist of a closed-circuit television system, necessary chemical sealant containers, sealant, pumps, regulators, valves, hoses, etc., and joint sealing packers for the various sizes of sewer pipes. The packer shall be cylindrical and have a diameter less than the pipe size and have cables attached at each end to pull it through the line. Jetting or driving pipes from the surface to apply grout is prohibited. Uncovering pipes via excavation for grout application is prohibited.

The system shall be sized to deliver a mixed volume of grout at a minimum of 3 GPM and 30 gallons of uninterrupted flow within 10 minutes.

The packer device shall be constructed in a manner to allow a restricted amount of sewage to flow. Generally, the equipment shall be capable of performing the specified operations in lines where flows do not exceed the maximum line flows for joint testing/sealing.

B. Joint Sealing Procedure.

1. Cleaning of Sewer Line: Prior to any joint testing or sealing within a pipe section designated to be joint sealed, it shall be the responsibility of the Contractor to clean the sewer line as specified.

2. Flow Control: The Contractor is responsible for diversion of wastewater in accordance with the applicable specification section.

3. Testing and Sealing: When a manhole section is designated to be joint sealed on the plans, all the joints within that section shall be tested and then sealed if and/as required.

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Mix, place and cure grout in accordance with the manufacturer's recommendations. Joint sealing shall be accomplished by forcing chemical sealing materials into or through faulty joints by a system of pumps, hoses, and a sealing packer. The packer shall be positioned over the faulty joint by means of a measuring device and the television camera in the line. The packer ends (end elements, sleeves) shall be expanded using controlled

pressure. The expanded ends shall seal against the inside periphery of the pipe to form a VOID area at the faulty joint, now completely isolated from the remainder of the pipeline. Into this isolated area, sealant materials shall be pumped through the hose system at controlled pressures which are in excess of groundwater pressures. The grout must be injected beyond the joint interface in to the soil surrounding the joint.

If a mainline or lateral joint requires more than 0.5 gallons of grout per inch of diameter of pipe, the grouting procedure shall be modified to stage grouting. Additional grout shall be pumped at 4 gallon increments. Wait time between stages is the greater of 1 gel set cycle or 1 full minute. The maximum number of stages shall not exceed 2 stages of 4 gallons each unless approved by the Engineer.

C. Joint Sealing Verification.

Upon completing the sealing of each individual joint, the packer shall be deflated until the VOID pressure meter reads zero pressure, then reinflated and the joint retested as specified. Should the VOID pressure meter not read zero, the Contractor shall clean his/her equipment or residual grout material or make the necessary equipment repairs/adjustments to produce accurate VOID pressure readings. Joints that fail to meet the specified test criteria shall be resealed and retested until the test criteria can be met in order to receive payment.

D. Residual Sealing Material.

Residual sealing materials that extend into the pipe, reduce the pipe diameter, or restrict the flow shall be removed from the joint. The sealed joints shall be left reasonably "flush" with the existing pipe surface. If excessive residual sealing materials accumulate in the line, the manhole section shall be cleaned to remove the residual materials. Payment for any cleaning operations performed to remove residual materials shall be incidental to the contract unit price for joint sealing.

E. Records.

Complete records, including pre- and post- joint sealing televising video, shall be kept of joint testing and sealing performed in each manhole section. The records shall identify the manhole section which the testing and sealing was done, the location of each joint tested and sealed, the test pressure used, the joint sealing verification results (pass or fail), and the quantity of chemical sealing material used at each faulty joint. The Contractor shall supply a copy of these records to the Engineer upon conclusion of the sealing work.

F. Guaranty.

All sewer pipe joint sealing work performed shall be guaranteed against faulty workmanship and/or materials for a period of two years after the completion of work.

Prior to the expiration of the guaranty period, an initial inspection area consisting of specific pipe sections will be selected by the Engineer. Pipe sections to be inspected will

be randomly selected throughout the project area and will be representative of the majority of the sealing work originally performed. The initial inspection area will consist of at least 10%, but not exceed 20% of the joints sealed in the original project.

Within the initial inspection area, the Contractor shall TV-inspect all previously sealed joints. All joints that are visibly leaking shall be resealed. If the number of leaking joints is less than 5% of the joints inspected, the work shall be considered satisfactory and no further inspection shall be required. Payment for the TV inspection shall be incidental to the joint test and joint seal bid items. No compensation will be provided for resealing joints that are leaking. If, in the initial inspection area, the number of leaking joints exceeds 5% of the joints inspected, an additional area of equivalent size will be selected and all previously sealed joints shall be inspected. This additional inspection and sealing, if necessary, shall continue until the number of leaking joints is less than 5%. Any additional inspection/sealing required beyond the initial inspection area shall be accomplished with no compensation to the Contractor.

G. Payment.

Payment for all labor set-ups and materials for line testing and seal operations will be paid under the pay item Joint Sealing at the unit price bid each. Grout will be paid at the unit price bid per gallon.

SECTION 5.00 - MANHOLE IMPROVEMENTS

5.01 SEWER MANHOLE SEALING

The intent of manhole sealing is to provide for the elimination of extraneous water leakage into the manholes that are structurally sound. The Contractor shall seal the manholes specified on the plans.

A. Equipment.

The basic equipment shall consist of chemical pumps, chemical containers, injection packers, hoses, valves, and all necessary equipment and tools required to seal manholes.

B. Manhole Sealing Procedures.

At each point of leakage within the manhole structure, the sealing procedure shall be performed using current best practices following product manufacturer's specifications.

C. Payment.

Payment for all labor set-ups and materials for sealing manholes will be paid under the pay item Grout Manhole at the unit price bid each. Grout will be paid at the unit price bid per gallon.

D. Final Acceptance.

After the manhole sealing operation has been completed, the manhole will be visually inspected for the elimination of excessive infiltration by the Engineer in the presence of the Contractor, and the work must be found satisfactory to the Engineer.

5.02 REBUILD MANHOLE INVERT

The intent of the rebuild manhole invert work is the complete removal, disposal, and reconstruction of existing manhole inverts. The Contractor shall rebuild the inverts for the manholes specified on the plans.

A. Procedure.

1. The Contractor shall bypass sewage around the manholes which are to have rebuilt inverts. All labor and materials necessary to perform the bypass shall be the responsibility of the Contractor, and payment shall be incidental to the rebuild manhole invert contract unit price.

2. The bottom of the sewer manhole shall be cleaned of all foreign material and matter prior to beginning the rebuilding work. Cleaning may be accomplished by waterblasting, sandblasting, or applying an acid solution. If an acid solution is used, it shall be washed off

and the manhole allowed to dry. Mixing, application and removal of the acid shall be done in strict accordance with the manufacturer's recommendations.

3. The manhole invert shall be rebuilt with quick-set non-shrinking cement type grout such that the trough is compatible with all incoming and outgoing pipe and their inverts.

B. Payment.

Payment for all labor and materials to bypass sewage, clean, remove, and rebuild existing manhole inverts shall be made on a per each basis under the bid item rebuild manhole invert.

C. Final Acceptance.

After the manhole invert has been rebuilt, the manhole shall be visually inspected by the Engineer in the presence of the Contractor, and all work must be found satisfactory to the Engineer.

5.03 MANHOLE DEBRIS

In order to limit the amount of debris and deleterious material that enters the sanitary system while working on sanitary manholes a manhole debris catcher, or "parachute", shall be used at the direction of the Engineer. The catcher must be able to open to a minimum diameter of 48 inches and have a capacity of 50 pounds and extend to the bottom of the manhole. The catcher shall allow unobstructed flow of the sanitary system at all times. If debris enters the sanitary system, the system shall be adequately cleaned and jetted to the satisfaction of the Engineer at no cost to the Owner.

6.00 CHEMICAL SEALING MATERIALS

6.01 CHEMICAL SEALING MATERIALS

The intent of this section is to define the properties and characteristics that a sealing material must have to perform effectively in the intended application and under expected field conditions. This material specification applies to both manhole sealing and sewer main joint sealing. Intended sealing products to be used shall be submitted to the engineer, for approval, a minimum of two weeks prior to the start of any work.

A. While being injected, the chemical sealant must be able to react/perform in the presence of water.

B. The cured material must be capable of withstanding submergence in water without degradation.

C. The resultant sealant formation must prevent the passage of water.

D. The sealant material, after curing, must be flexible as opposed to brittle or rigid.

E. In place, the resultant sealant formation should be able to withstand freeze/thaw and wet/dry cycles without adversely affecting the seal.

F. The sealant formation must not be biodegradable. Additives may be used to meet this requirement.

G. The cured sealant should be chemically stable and resistant to concentrations of acids, alkalis, and organics found in normal sewage.

H. Packaging of component materials must be compatible with field storage and handling requirements. Package must provide for worker safety and minimize spillage during handling.

I. Mixing of component materials must be compatible with field operations and not require precise measurements.

J. Cleanup must be done without inordinate use of flammable or hazardous chemicals.

K. Residual sealing materials must be removable from the sewer after injection to ensure no flow reduction, restriction, or blockage of normal sewage flows.

L. The grout material must have the ability to increase mix viscosity, density, and gel strength by increased concentration of constituents or the use of approved additives.

SECTION 7.00 – CIPP - MAINLINE TRENCHLESS PIPE RELINING/SHORT LINER

7.01 GENERAL REQUIREMENTS

A. Intent.

It is the intent of this specification to provide requirements for furnishing of all labor, materials, tools, design, transportation, equipment and performances of all work and services incidental to the installation of a resin-impregnated flexible liner which is inserted into the original conduit by use of a hydrostatic head. Methods that are pulled in and inflated rather than inverted will be considered, providing they meet the other provisions of this specification. When cured, the finished Cured-in-Place-Pipe (CIPP) will be continuous and tight fitting.

B. Reference Specifications.

This specification references American Society for Testing and Materials (ASTM) standard specifications, which are made a part hereof by such reference and shall be the latest edition and revision thereof.

F-1216 Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube

F – 1743 Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Pull in and inflate and Curing of a Resin-Impregnated Tube.

F-2019 Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Pulled in Place Installation of Glass Reinforced Plastics (GRP) Cured-In-Place Pipe (CIPP)

F - 2561 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.

D - 543 Test Method for Resistance of Plastics to Chemical Reagents

D - 578 Standard Specification Glass Fiber Strands

D – 638 Standard Test Method for Tensile Properties of Plastics

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

D - 2122 Standard 1 Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings

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

D - 3567 Standard Practice for Determining Dimensions of ‘‘Fiberglass’’ (Glass-Fiber Reinforced Thermosetting Resin) Pipe and Fittings

D - 5813 Standard Specification for Cured-in Place Thermosetting Resin Sewer Pipe

C. Design Considerations.

The minimum length of the pipe liner shall be that deemed necessary by the Contractor to produce a finished pipe tightly formed to the existing pipe and which effectively spans the distance from the inlet to the outlet of the respective manholes. Individual insertion runs can be made over one or more manhole sections as determined in the field by the Contractor and approved by the Engineer.

The wall color of the interior pipe surface of the pipe after installation shall be a light-reflective color so that a clear detail examination with closed-circuit television inspection equipment may be made.

The Contractor shall be responsible for all aspects of the design of the rehabilitation pipe. The Contractor shall guarantee that the installed pipe is capable of sustaining outside loads, resisting chemical attack that normally occurs in sanitary sewer, and will maintain hydraulic characteristics over a fifty-year design life. No design shall rely on bonding to the existing pipe or rely on the remaining strength of the existing pipe.

The following is requested from the low bidder:

1. Certified test results from the manufacturers which indicate that all materials conform to the applicable requirements.

2. A copy of the license or certificate verifying the manufacturer’s or licensor’s approval of the Installer.

3. The Contractor shall submit test results of the resin proposed that meet the chemical resistance requirements of ASTM F2019, Section 5.2.6. The chemical resistance tests will be completed in accordance with Test Method D543.

4. Field samples shall be submitted and shall be in accordance with ASTM – F2019 and ASTM - D5813.

5. The Contractor shall submit Material Safety Data Sheets for all resins, and other additives such as accelerants, colorants, and lubricants utilized in the pipe liner/lining process.

6. The Contractor shall submit an informational handout that describers the materials, processes, installation, pressures, temperature limitations, and recommended post curing documentation.

7. The Contractor shall submit an informational hand out that described the materials, processes, installation, pressures, temperature limitations, and odors associated with the lining process that shall be provided at the request of concerned individuals.

8. The Contractor shall submit liner pipe thickness design for each pipe segment. No liner will be approved for installation until liner thickness calculations have been submitted and reviewed for conformance with this specification.

9. The Contractor shall submit a plan for temporary conveyance of sewer flows and bypass monitoring.

10. The Contractor shall submit a construction schedule and maintain its operation to meet the provided schedule.

11. The Contractor shall submit evidence of the installer's experience including a list of similar projects completed within the previous 2 years. Final decision regarding a Contractors qualification will be made solely by the City or its Engineer.

12. The Contractor shall submit a description of the cure method(s) proposed by the contractor.

A copy of the design parameters and the calculations used to calculate liner thickness and strength shall be submitted to the Engineer. Standard formulas as used in the design of flexible pipes shall be used for the design calculations. The following design parameters shall be included in the submittal:

	Standard	**CIPP Value**	**UV Value**
Flexural Strength	ASTM - D790	4,500 psi	6,500 psi
Modulus of Elasticity	ASTM - D790	250,000-400,000 psi	725,000 psi

Pipe diameter		Inches
Maximum depth from finished ground to invert		Feet
Minimum depth from finished ground to invert		Feet
Groundwater Depth		Feet
Cover density (assumed)	120	Lbs/cf
Design Safety Factor (1.5 for pipes 36 inches and larger)	2.0	Value
Ovality	2% - 5%	Percent
Enhancement Factor (K)	7.0	Value
Poisson's Ratio	0.3	Value
Level of Deterioration	Fully Det	Value

Creep Retention Factor	50%	Value
Soil Modulus	1,000 PSI (Less than 15 feet deep), 1,500 PSI (More than 15 feet deep)	Value
Host Pipe Loading	H20 Highway	Value

The minimum acceptable design criteria shall be as follows:
The pipe liner shall be designed to fit the existing sanitary sewer. The pipe liner shall be fabricated to a size that, when installed, will tightly fit the internal circumference and length of the original pipe.

The existing sewer shall be considered to be in a fully deteriorated gravity condition and that the original pipe is not structurally sound and cannot support soil and live loads. The cured-in-place-pipe shall be designed to support hydraulic, soil, and live loads.

The pipe liner shall have a minimum flexural strength of 4,500 psi and a minimum modulus of elasticity of 250,000 psi, however a modulus of elasticity of 400,000 psi is preferred to limit the liner thickness. When using a CIPP liner with a UV cure, the minimum flexural strength becomes 6,500psi and the minimum modulus of elasticity becomes 725,000 psi.

The Contractor shall coordinate with the Engineer and Owner to determine the height of water over the pipe. A Factor of Safety of 2.0 shall be used in all calculations. The assumed cover density shall be 120 pounds / cubic foot. An enhancement factor of 7.0 shall be used. The Poisson's Ratio shall be 0.3. The liner shall have a creep retention factor of 50%. The host pipe loading shall be assumed to be H20 Highway unless approved otherwise.

The ovality of the host pipe shall be measured when viewing existing televising of the network prior to CIPP installation. When there are no televising videos available prior to the Contract, an ovality between 2% - 5% shall be used.

1,000 PSI soil modulus can be used for pipes buried less than 15 feet deep. 1,500 PSI soil modulus can be used for pipes buried deeper than 15 feet deep.

Overall condition of the pipeline system shall be maintained with its hydraulic profile as large as possible. Offsets of two adjacent pipe sections more than 25 percent of the diameter of the pipe shall be repaired by grinding and/or straightening the offset to be a useable shape in a manner mutually acceptable between the Contractor and the Engineer.

Calculated capacities may be derived using a commonly accepted roughness coefficient for the existing pipe material, taking into consideration its age and condition.

The Contractor shall submit the details of the proposed processing, including the steps, the pressure (specified steam air, water, or UV), the duration and the temperatures. When processing at temperatures near the melting temperature, the Contractor shall demonstrate how the pipe liner is to be contained or protected from blowouts. Any damage, either to the

pipe or property of others shall be repaired at the Contractor's expense, to the satisfaction of the parties involved.

7.02 MATERIALS

A. Cured-in-Place Pipe (CIPP)

1. The tube material and design considerations shall meet the requirements of ASTM F1216 and/or ASTM F2019. Section 5.1 and modified as follows.

2. The tubes shall have a uniform thickness that when compressed at installation pressures will equal the specified nominal tube thickness. The finished/cured thickness of the liner must exceed the design parameters specified in section 7.01.

3. The outside layer of the tube (before inversion) shall be plastic-coated with a translucent flexible material that clearly allows inspection of the resin impregnation (wetout) procedure. The plastic coating shall not be subject to delimitation after curing.

4. The tube shall be homogeneous across the entire wall thickness containing no intermediate or encapsulated elastomeric layers. No materials shall be included in the tube that is subject to delimitation in the cured pipe.

5. The resin system shall meet the requirements of ASTM F1216 and/or F2019 as specified in section 7.01. NEAT Resin or lower curing temperature shall be used on PVC pipes that are designated to be lined with this project.

6. A certificate of compliance with these specifications shall be provided to the Engineer prior to manufacturing the pipe liner.

7.03 INSTALLATION

A. Incidental Items.

Safety - The installer shall carry out their operation in strict accordance with all OSHA and manufacturers' safety requirements. Particular attention is drawn to those safety requirements involving entering confined spaces.

1. Traffic Control - Traffic control shall be the responsibility of the Contractor and shall conform to latest version of the MUTCD and other portions of these specifications and the contract Special Provisions. The Contractor shall maintain traffic during work periods. During non-working periods, the Contractor shall open the entire roadway to traffic.

2. Access - It will be the responsibility of the Engineer to locate and designate all manhole access points open and accessible from the work and provide rights of access to

these points. If a street must be closed to traffic because of the orientation of the sewer, the Contractor shall institute the actions necessary to do this for the mutually agreed time period.

3. Water Usage - Water is available from designated City fill stations for cleaning, inversion, and other work requiring water. However, the Contractor shall secure permission from the Water Department and obtain the necessary permits and pay the fees associated with the permit and water usage.

4. Cleaning of Sewer Lines - The Contractor shall remove all internal debris out of the sewer line that will interfere with the installation of the pipe liner using cleaning procedures outlined elsewhere in these specifications.

5. Bypassing Sewage - The Contractor shall provide the flow of sewage around the section or sections of pipe designated for repair. The bypass shall be made by plugging the line at an existing upstream manhole and pumping the flow into a downstream manhole or adjacent system. The pump and bypass lines shall be adequate capacity and size to handle the flow. The Engineer shall be furnished a detail of the bypass plan.

6. Inspection of Pipelines – Televised inspections of the pipeline shall occur before and after the insertion of the liner. Inspection of pipelines shall be performed by experienced personnel trained in locating breaks, obstacles, and service connections by closed circuit television. The interior of the pipeline shall be carefully inspected to determine the location of any condition which may prevent proper installation of the pipe liner into the pipelines and it shall be noted so that these conditions can be corrected. After the liner is installed, the interior of the pipeline shall be re-inspected to determine the location of any damages or issues that occurred during the lining process so that these conditions can be corrected.

A DVD in PACP format and suitable log shall be kept for later reference by the City of Chanhassen. The Engineer has copies of the televised sewer inspections to be relined; these are available for prospective bidders. However, since the deterioration of sewer is an ongoing process and roots, solids, and deposits can accumulate over time, the Contractor shall base the design of the liner on inspections made immediately prior to installation.

7. Line Obstructions - It shall be the responsibility of the installer to clear the line of obstructions such as solids, dropped joints, roots, protruding service connections, and collapsed pipe that will prevent the insertion of the pipeliner. If inspection reveals an obstruction that cannot be removed by conventional sewer cleaning equipment, the installer shall be required to make a point repair excavation to uncover and remove or repair the obstruction. All costs associated with this repair work and all associated restoration work including the replacement of asphalt pavement, curb and gutter, sodding, etc., shall be negotiated as a change order and reviewed/approved prior to commencing with the work.

The Contractor shall be required to remove any protruding taps to the inside wall of the pipe. In no case shall the pipe be less than 95% open to flow.

8. Service Connections

The Contractor shall certify that he has a minimum of two complete working cutter units plus spare key components on the site before each inversion.

Prior to installing the sewer liner, the Contractor shall verify which services are active via dye testing. A record of the location of all sewer lateral connections that are in questions must be maintained, which shall be submitted to the Owner. The Owner will then determine which, if any, sewer services are to be abandoned. Those services designated to be abandoned will not be reinstated.

After lining is complete, the Contractor shall re-establish all service connections except those designated by the Owner to be abandoned. This shall be done without excavation from the interior of the pipe by means of a television camera and a remotely controlled cutting device. If the Contractor is unable to re-establish the service connection from inside the pipe and an excavation is necessary, no additional payment will be made for excavations for the purpose of reopening connections and the Contractor will be responsible for all costs and liability associated with such excavation and restoration work. Re-established service connections shall be clean and smooth, free of jagged edges and conform as closely as possible to the dimension of the existing service. Brush style cutters or similar devices will be required to ensure that the laterals are smooth for potential CIPP lining.

The sewer main shall be lined prior to lining service laterals, unless approved otherwise by the Engineer.

9. Finish - The reconstructed pipe shall be continuous, without joints over the entire length of the pipe. The liner shall be free of all visual and material defects except those resulting from pre-lined conditions (such conditions shall be brought to the attention of the Engineer prior to pipelining work). There shall be no pits, pinholes, cracks, or crazing. The surface shall be smooth and free of waviness throughout the pipe.
Any defects (or wrinkles) that will affect the structural integrity of the reconstructed pipe shall be repaired or the pipe liner will be replaced at the Contractor's expense.

10. Final Sewer Cleaning - After the installation work and testing has been completed to the satisfaction of the Engineer as specified elsewhere in these specifications, the Contractor shall flush and clean all parts of the system. Remove all accumulated construction debris, rocks, gravel, sand, silt, and other foreign material from the sewer system at or near the closest downstream manhole. If necessary, use water jet, mechanical rodding, or bucketing equipment.

Upon the Engineer's final manhole-to-manhole inspection of the sewer system, if any foreign matter is still present in the system, reflush and clean the sections and portions of the lines as required.

11. Final Televising of Sanitary Sewer – After all testing and cleaning is completed; the Contractor shall provide the Engineer with a DVD in PACP format with GIS assets and a

report showing the entire length of completed sewer lining work. The televising shall meet the criteria specified elsewhere in these specifications.

12. Sealing Liner at Manholes - The Contractor will be required to provide/install a LMK Insignia (or approved equal) hydrophilic end seal at the ends of the liner in each manhole to prevent water tracking between the liner and the existing pipe.

The seal shall be approved by the Owner. Payment for the installation of the seal shall be incidental to the installation of the pipeliner.

13. Notifications – At least 7 days before the start of lining, the Contractor shall provide notice to the adult residents of effected buildings and to the owner or administrator of any property directly served by the sewer to be lined. This notification must be mailed or hand delivered to the owner or administrator of a child care building, school building, commercial businesses, and/or industry. This notification shall include the approximate schedule of lining and specify the days and hours during which the sewer service will be restricted.

14. Reminder Notice – A written reminder notification shall be delivered 24 hours prior to the sewer lining to the adult residents of buildings and the owner or administrator of properties, child care buildings, school buildings, commercial businesses, and/or industry directly served by the sewer to be lined.

B. Installation of Cured-in-Place Pipe, CIPP

1. The CIPP installation shall be in accordance with ASTM F1216, Section 7, with the following additional requirements.

Resin Impregnation - The quantity of resin used for liner impregnation shall be sufficient to fill the volume of air VOIDS in the liner with additional allowances for polymerization shrinkage and the loss of resin through cracks and irregularities in the original pipe wall. A vacuum impregnation process shall be used to uniformly distribute the resin throughout the liner. A roller system shall be used to uniformly distribute the resin throughout the liner.

Liner insertion shall be performed in accordance with the manufacturer's recommendations and in such a way to fully extend the liner to its termination point, hold the liner tight against the pipe wall, and produce dimples at service connections and flared ends at maintenance holes. Lubricants may be used as necessary. Care shall be taken so as not to overstress the felt liner.

a) Unless otherwise indicated in the plans or authorized in writing by the Engineer, steam curing, water curing, and UV curing shall all be considered as an acceptable cure method for this project. Steam Cure

(1) After inversion is completed, suitable steam-generating equipment is required to distribute steam throughout the pipe.

(2) The equipment should be capable of delivering steam throughout the section to uniformly raise the temperature within the pipe above the temperature required to effect a cure of the resin.

(3) The temperature and pressure maintained in the pipe and the duration of the cure period shall be as recommended by the manufacturer.

(4) The curing of the CIPP must take into account the existing pipe material, the resin system, and ground conditions (temperature, moisture level, and thermal conductivity of soil).

(5) Cooling:

(a) The new pipe should be cooled to a temperature below 113 degrees Fahrenheit before relieving the internal pressure within the section.

(b) Cool-down may be accomplished by the introduction of cool water into the section to replace the mixture of air and steam being drained from a small hole made in the downstream end.

(c) Care shall be taken in the release of head so that a vacuum will not be developed that could damage the newly installed pipe.

b) Circulated Heated Water Cure

(1) After inversion is completed, suitable heat source and water recirculation equipment are required to circulate heated water throughout the pipe.

(2) The equipment should be capable of delivering hot water throughout the section to uniformly raise the water temperature above the temperature required to effect a cure of the resin.

(3) The heat source should be fitted with suitable monitors to gauge the temperature of the incoming and outgoing water supply. Another such gauge should be placed between the impregnated tube and the pipe invert at the termination to determine the temperatures during cure.

(4) The temperature and pressure maintained in the pipe and the duration of the cure period shall be as recommended by the manufacturer.

(5) The curing of the CIPP must take into account the existing pipe material, the resin system, and ground conditions (temperature, moisture level, and thermal conductivity of soil).

(6) Cooling:

(a) The new pipe should be cooled to a temperature below 100 degrees Fahrenheit before relieving the static head in the inversion stand pipe.

(b) Cool-down may be accomplished by the introduction of cool water into the inversion stand pipe water to replace hot water being drained from a small hole made in the down-stream end.

(c) Care shall be taken in the release of head so that a vacuum will not be developed that could damage the newly installed pipe.

c) UV Cure – Follow ASTM F2019, Section 6.6 & 6.7

(1) The approved system must utilize an outer and inner film to ensure that the liner remains intact during the insertion process and to protect the resin at all times during the installation and curing process from water and debris contamination and resin migration.

(2) A winch should be used to pull the glass fiber liner into position in the pipe. The pulling speed shall not exceed 15ft/min. The liner shall have a lateral fiberglass reinforcement band which runs the entire length of the liner ensuring that the pulling force is transferred to the band and not the fiberglass liner. Once inserted, end plugs shall be used to cap each end of the glass fiber liner to prepare for pressurizing the liner. As with all CIPP products liner restraints should be used in manholes.

(3) A slip sheet shall be installed on the bottom one third to one half of the pipe prior to liner insertion, for the purpose of protecting the liner during insertion and reduce the drag, or as recommended by the liner manufacture.

(4) The glass fiber liner shall be cured with UV light sources at a constant inner pressure. When inserting the curing equipment in the liner, care should be taken to not damage the inner film material.

(5) The UV light sources should be assembled according to the manufacture's specification for the liner dimeter. For the liner to achieve the required water tightness and specified mechanical properties, the following parameters must be controlled during the entire curing process, giving the Engineer a record of the curing parameters over every segment of the entire length of the liner. This demonstrates that the liner is cured properly. The recording will include:

(a) Curing Speed

(b) Light Source and Wattage

(c) Inner Air Pressure

(d) Curing Temperatures

(e) Date and Time

(f) Length of Liner

This will be accomplished using a computer and data base that are tamper proof. During the curing process, infrared sensors will be used to record curing data that will be submitted to the Engineer with a post CCTV inspection on the portable hard drive.

(6) The optimal curing speed, or travel speed of the energized UV light sources, is determined for each length of liner based on internal diameter, liner thickness, and exothermic reaction temperatures.

(7) The inner film material should be removed and discarded after cuing to provide optimal quality of the final product.

2. Testing of the completed CIPP shall include the following:

a) CIPP field samples shall be prepared in accordance with the ASTM F1216, Section 8.1, using either method proposed.

b) The Contractor shall certify that the CIPP shall meet the chemical resistance requirements of ASTM F1216, Appendix X2. CIPP samples for testing shall be of liner and resin system similar to that proposed for actual construction. It is required that CIPP samples with and without plastic coating meet these chemical testing requirements.

c) Leakage testing of the CIPP shall be accomplished during cure while under a positive head. Products in which the pipe wall is cured while not in direct contact with the pressurizing fluid (e.g., a removable bladder) must be tested by an alternative method approved by the Owner

d) Visual inspection of the CIPP shall be in accordance with ASTM F1216, Section 8.4.

e) The Contractor shall be responsible for the testing and associated costs.

7.04 MEASUREMENT AND PAYMENT

A. Measurement & payment of sewer lining pipe shall be by the linear foot measured to the nearest foot between centers of manholes for end to end mainline CIPP lining.

B. Measurement & payment for CIPP short liners shall be paid per each (EA) for the specific length provided in the bid form.

C. Payment for sewer lining pipe by the linear foot/each for each specified liner thickness and diameter of existing sewer pipe shall include full compensation for all labor, equipment, and materials necessary to complete the work as specified and no additional compensation will be made therefore. All traffic control required for the trenchless pipe relining work shall be incidental, with no separate compensation given.

Pre-lining and post-lining televising inspections shall be incidental to the sewer lining work with no separate compensation given.

All items part of section 7.00 are to be fully guaranteed by the Contractor for a period of 2 years from the date of Final Acceptance unless otherwise stipulated in writing y the Owner prior to the date of Conditional Acceptance. During this period, all serious defects discovered by the Owner or Engineer will be removed and replaced by the Contractor in a satisfactory manner at no cost to the Owner. In addition, the Owner may conduct independent televised inspections, at its own expense, of the lining work at any time prior to the completion of the guarantee period.

SECTION 8.00 - TELEVISION INSPECTION

Televising shall be performed on all newly constructed or repaired gravity sanitary sewer lines after successful leak testing has been completed and accepted. Contractors and developers shall follow all requirements for televising as outlined in current City specifications at the time of project.

8.01 TELEVISION EQUIPMENT

Television equipment shall include television camera, television monitor, cables, power source, lights, and other equipment. The television camera shall be specifically designed and constructed for operation in connection with sewer rehabilitation inspection. The Contractor shall utilize a self-propelled type camera where shown on the plans or required by the Engineer.

The camera, television monitor, and other components of the recording system, will be capable of producing a color picture in high definition resolution. The percentage of pipe slope shall be displayed on the screen and video relative to the camera's location.

The camera will be mounted so as to center the lens for each pipe diameter to be investigated. The Contractor shall guarantee to accurately measure pipe diameters of both main and service laterals as well as pipe defects.

The camera will be operative in 100% humidity conditions. Lighting for the camera will minimize reflective glare. Lighting and camera quality will be suitable to provide a clear, in-focus picture of the entire inside periphery of the sewer pipe for all conditions encountered during the work. Focal distance will be adjustable through a range of from 6" to infinity.

The remote reading footage counter will be accurate to one percent over the length of the particular section being inspected and will appear superimposed on the image shown on the television monitor.

At the Contractor's option, a push-type camera can be used to televise laterals.

8.02 TELEVISION INSPECTION PROCEDURES

The camera shall be moved through the line in either direction at a uniform rate, stopping when necessary to ensure proper documentation of the sewer's condition. In no case will the television camera traverse the line being inspected for the line length at an average speed greater than 30 feet per minute. The contractor will stop at each service or defect a minimum of 10 seconds and using the pan and tilt of the camera fully view each service connection/defect. If, during the inspection operation, the television camera will not pass through the entire manhole section, the Contractor will reset their equipment in a manner so that the inspection can be performed from the opposite manhole. A reset or back out charge due to debris in the lines will be considered incidental to the televising pay item.

All lines shall be jetted and vacuumed so that all debris has been removed prior to televising.

A small quantity of water is to be introduced into the line prior to televising. The amount shall be determined by the Engineer and coordinated with the City's Water and Sewer Department. The amount of water shall be sufficient enough to distinguish any sags or alignment problems with the pipe.

A fan/vacuum shall be utilized if steam given off by the sanitary sewer affects the camera visibility.

Examine starting and ending doghouses for quality of mortar work.

While at the bottom of the manhole, the camera will examine all joints as high as it can see around the entire manhole circumference. Joints shall be examined for infiltration and excessive gaps.

All outside drops shall be noted and visually examined looking down from the top.

Provide starting and ending manhole depths to the nearest 0.5'.

Include the location relative to the zero starting point, the side (left of right), and the clockwise position of the wye (i.e. 10:00). Note any problems associated with the service wye.

In the event the section being televised has substantial flow entering the sewer between manholes, such that 20% or 25% of the pipe diameter is flowing for 6”-10” pipe and 12”-24” pipe, respectively, the Contractor will coordinate with the Engineer to have such flow temporarily stopped and/or reschedule television inspection of the particular section to a time when such flow is reduced to permit proceeding with the television inspection. Any required by-passing or “pigging” is considered incidental.

When sewer line depth of flow at the upstream manhole of the section being televised is above the maximum allowable for television inspection, the Contractor will reduce the flow to permit proceeding with the television inspection.

Accuracy of the measurement meters will be checked daily. Footage measurements will begin at the sewer line point of penetration of the upstream manhole, unless specific permission is given to do otherwise. Footage will be shown on the data view/monitor at all times.

8.03 DOCUMENTATION OF THE TELEVISION RESULTS

Television inspection logs will be typed in format acceptable to the City. Samples of the video and inspection log and PACP certification shall be submitted prior to bid acceptance, unacceptable submittals shall be rejected. Two written reports are required along with a brief summary report of noted items in each segment recorded on the project at the front of the report log. Printed location reports will clearly show the location, in relation to adjacent manholes, of each source of infiltration discovered. In addition, other data of significance, including the location of buildings and house service connections, joints, unusual conditions, roots, storm sewer connections, collapsed sections, presence of scale and corrosion, and other discernible

features, will be recorded. A voice recording embedded in the digital video recording will make brief and informative comments on the sewer conditions at the time of recording.

Color digital video recordings of the data on the television monitor will be made by the Contractor. One copy of each video, in certified PACP format, on a digital hard drive containing all video, printable reports and still photos will be provided to the City.

Digital video recording playback will be the same speed that it was recorded.

Title and ownership of the digital hard drive will remain with the City. The Contractor will have all video and necessary playback equipment readily accessible for review by the City during the project. Recording speed will be noted on the recorded digital video.

Digital hard drive submittals will include the following information:

A. Data view:

1. Report number.
2. Date and time of TV inspection.
3. Upstream and downstream manhole numbers.
4. Current distance along reach (distance counter footage).
5. Printed labels on DVD hard case and DVD disk with location information, date, format information, and other descriptive information.
6. All televising data must match the GIS asset ID's provided by the City.

B. Audio:

1. Date and time of TV inspection, operator name and name of adjacent streets or descriptive narration of easement.
2. Verbal confirmation of upstream and downstream manhole numbers and TV viewing direction in relation to direction of flow.
3. Verbal or electronic description of pipe size, type, and pipe joint length.

C. Typed logs will include, but are not limited to, the following information:

1. Location of each point of leakage.
2. Location of each service connection.
3. Location of any damaged sections, nature of damage, and location with respect to pipe axis.
4. Deflection in alignment of grade of pipe.
5. Record of repairs and quantity of sealing material used (if applicable).
6. Date, time, city, street or easement, basin, manhole section, reference manhole number, name of operator, inspector, and weather conditions.
7. Pipe diameter, pipe material, section length, and corresponding DVD identification.

8.04 MEASUREMENT AND PAYMENT

A. Measurement of sewer televising will be by the linear foot completed, measured to the nearest foot between centers of manholes.

B. Payment for sewer televising by the linear foot will include full compensation for all labor, equipment, and materials necessary to complete the work as specified and no additional compensation will be made therefore.

SECTION 9.00 – CURED-IN-PLACE-PIPE LATERAL LINER (CIPPLL)

9.01 GENERAL REQUIREMENTS

A. Intent.

These specifications include requirements for all design, materials, transportation, equipment, tools, and labor necessary to the structural re-construction of 4.0-inch thru 6.0-inch diameter service laterals and a water tight interface connection seals in 6.0-inch through 36.0-inch main line pipes, normally without excavation, by the installation of a one piece resin impregnated, flexible, non-woven felt liner installed into the existing lateral connection to the City's right-of-way line, or in the case where the public sanitary main is located in a public drainage and utility easement to the easement line, utilizing a pressure apparatus positioned in the main pipe.

B. Reference Specifications.

This specification references ASTM standard specifications, which are made a part hereof by such reference and shall be the latest edition and revision thereof.

F - 1216 Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube

F – 1743 Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Pull in and inflate and Curing of a Resin-Impregnated Tube.

F - 2561 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.

D - 5813 Standard Specification for Cured-in Place Thermosetting Resin Sewer Pipe

C. Design Considerations.

General Corrosion Requirements: The finished pipe in place shall be fabricated from materials which will be chemically resistant to withstand internal exposure to domestic sewage.

The structural performance of the finished cured-in-place-pipe must be adequate to accommodate all anticipated loads throughout its design life. No cured-in-place-pipe reconstruction technology will be allowed that requires bonding to the existing pipe for any part of its structural strength. Only resin saturation using vacuum impregnation will be allowed.

Design methods are to be derived from traditionally accepted pipe formulas for various loading parameters and modes of failure. All equations will be modified to include ovality as a design parameter. The design method will be submitted to the Engineer for approval.

The CIPP Lateral Liner shall conform to the following properties:

1. The installed pipe meets the relevant sections of ASTM F-1216. The CIPP design shall assume no bonding to the original host pipe. Only resin saturation using vacuum impregnation will be allowed.

2. The layers of the cured CIPP shall be uniformly bonded. It shall not be possible to separate any two layers with a probe or a point of a knife blade so that the layers separate cleanly or the probe or knife blade move freely between layers.

3. If separation of the layers occurs during testing of field samples, new samples will be cut from the work. Any reoccurrence may cause rejection of the work.

4. The CIPP Short Liner shall conform to the following properties:

	Standard	Min Value
Flexural Strength	ASTM - D790	4,500 psi
Modulus of Elasticity	ASTM - D790	250,000 psi

The required structural CIPP wall thickness shall be based as a minimum, on the physical properties listed above and in accordance with the design equations in the appendix of ASTM F1216 and ASTM F2561. The 4.0-inch through 6.0-inch diameter lateral liner shall be designed assuming a fully deteriorated pipe conditions. The main line pipe liner may be considered as a partially deteriorated pipe when the mainline is previously lined. The main line pipe liner shall be considered fully deteriorated when the main line pipe is NOT lined.

Tests for compliance with this specification shall be made according to the applicable ASTM specification. A certificate of compliance with this specification shall be provided upon request. All materials used in the reconstruction process shall be made of the best respective kinds and to the satisfaction of the Owner. Any materials not approved by the Owner shall be rejected prior to the reconstruction of the sewer. The following shall be submitted to the Engineer for approval prior to any lateral lining:

1. Submittals about the Resin used shall include long term creep test data confirming the resin system's 50-year design life in accordance with ASTM D2990. A certificate of compliance with ASTM – F1216 must be included. The Contractor shall also submit any Materials Safety Data Sheets for any chemicals used in the CIPPLL.

2. The Contractor shall submit a certificate of compliance for the liner in accordance with ASTM - F1216 for inversion of tubes, and ASTM – F1743 for pull in place tubes.

These rejected materials shall then be replaced with approved materials at the Contractor's expense. The Contractor guarantees the quality of the liner during manufacturing and after

installation. The outside diameter and minimum wall thickness shall be fabricated to a size that when installed, will neatly fit the internal circumference of the conduit, with a minimum 5.0-inches on either side of the connection. Allowance will be made for circumferential stretching during the liner insertion. The installed liner will be a jointless polyester felt "tube" with sewn seams and/or a semi-rigid collar at the connection that will create a watertight seal at the mainline pipe interface. Standard dimension ratio of the liner shall be based on the evaluation of the design consideration. These considerations normally include an evaluation of 1) Flow capacity, 2) External loads (hydrostatic pressure and/or static and dynamic earth loads), and 3) internal pressure, if applicable.

9.02 MATERIALS

The liner and resin will meet the requirements of ASTM – F1216 (or ASTM – F2561), F1743, and D5813. The liner length will be a distance to effectively span from the lateral connection at the main line pipe to the City's right-of-way line, or in the case where the public sanitary main is located in a public drainage and utility easement to the easement line, and terminate before crossing said lines, with a minimum of 3 feet into the service lateral. When required, an overlap method will be performed with a pull-in-process installation from a cleanout or access point back to the main line pipe. The lateral liner must provide a watertight seal at the main pipe and a structural repair of the lateral over the specified length. Installer will verify the lengths in the field before impregnation of the resin.

Approved products that can be installed for this project include, BLD "Service Connection Seal + Lateral" of BLD Services LLC; LMK "T-Liner" Main-to-Lateral Lining System; Perma-Liner Industries, LLC – Innerseal Lateral Liner – Full Wrap Lateral Liner; Trelleborg LCR – Full Wrap Lateral Liner; or a City Engineer approved equal.

9.03 INSTALLATION

A. Installation Procedure.

The following installation procedure shall be adhered to unless otherwise approved by the Owner's representative.

1. Safety - The Installer shall carry out his/her operations in strict accordance with all OSHA and manufacturers' safety requirements. Particular attention is drawn to those safety requirements involving entering confined spaces.

2. Traffic Control - Traffic control shall be the responsibility of the Contractor and shall conform to latest version of the MNMUTCD and other portions of these specifications and the contract Special Provisions. The Contractor shall maintain traffic during work periods. During non-working periods, the Contractor shall open the entire roadway to traffic.

3. Access – A cleanout is not required for installation. However, if a cleanout already exists, or is required by the Owner, it will be constructed of materials which provide a 6.0-

inch minimum diameter opening. The cleanout will conform to other parts of these specifications.

4. Notifications - Providing all required notifications as outlined in section 7.03 of this specification.

5. Dye Testing - Dye testing as required to determine active laterals where needed.

6. Cleanouts - Installation of cleanouts shall be incidental to this specification (if required and not already covered with a separate bid item). If a cleanout needs to be constructed, it shall match the size of the lateral it is connected to and include any additional restoration work to complete the installation.

7. Water Usage - Water is available from designated City fill stations for cleaning, inversion, and other work requiring water. However, the Contractor shall secure permission from the Utility Department and obtain the necessary permits and pay the fees associated with the permit and water usage.

8. Cleaning of Sewer Line - It shall be the responsibility of the Installer to remove all internal debris from the service line in accordance with Section 2.00.. The intent of this specification is for cleaning of the lateral to be accomplished from the main pipe via lateral launching equipment. If the lateral cannot be cleaned using industry standard cleaning heads that can be launched from the main pipe, then a cleanout or access point will be required. The laterals will be cleaned a sufficient length to ensure the specified length of sewer is ready for lining. Installer will be responsible to verify, prior to installation, that all internal debris has been removed from the sewer line. Internal debris consists of broken pipe sections, roots, loose gravel, etc

9. Inspection of Sewer Line - Inspection of pipelines shall be performed by experienced personnel trained in identifying breaks, obstacles and service connections by closed circuit television. The interior of the pipeline shall be carefully inspected to determine the location of any conditions which may prevent proper installation of the lateral liner pipe into the sewer line, and it shall be noted so that these conditions can be corrected. A DVD in PACP format and suitable log shall be kept for later reference by the Owner.

10. Bypassing Sewage - The Installer, when required, shall provide for the flow of sewage around the section or sections of pipe designated for lining. The bypass shall be made by plugging the line at an existing manhole and pumping the flow into a downstream manhole or adjacent system. The pump and bypass lines shall be of an adequate capacity and size to handle the flow.

11. Line Obstructions - It shall be the responsibility of the Installer to clear the line of obstructions such as solids, roots, protruding service connections and collapsed pipe that will prevent the insertion of the CIPP lateral liner pipe.

If inspection reveals an obstruction that cannot be removed by conventional sewer cleaning equipment, then the Installer shall make a point repair excavation to uncover and remove or repair the obstruction. Such excavation shall be approved in writing by the Owner's representative prior to the commencement of the work and shall be considered a separate cost item.

12. Wet Out - Installer will designate a location where the liner will be vacuum impregnated prior to installation. Installer will allow the Owner to inspect the materials and resin saturation (wet-out) procedure. A catalyst system compatible with the resin and liner will be used.

13. Liner Installation – It is required that the service lateral be inactive during the time of installation. This will be accomplished by turning off the homeowner's services or requesting that the homeowner relinquish using his services during the period of installation. Notifications will be handed out to impacted residents 24 hours prior to the commencement of work.

The Installer will designate a location where the liner will be vacuum impregnated prior to installation. The Installer will allow the Owner to inspect the materials and resin saturation (wet-out) procedure. A catalyst system compatible with the resin and liner will be used.

The wet-out liner will be loaded inside a pressure apparatus above ground, utilizing a hydrophilic sealant (or equivalent) on the backside of the connection applied in a ½-inch to 1.0-inch wide bead (or gasket per ASTM F2561) to enhance a watertight seal. Also, a Silicate Resin or a two-part 100 percent solid epoxy (reference ASTM C-881) will be applied at a volume no less than 6oz to the lateral interface to enhance adhesion against the host pipe. The pressure apparatus, with an end attached to a robotic device, will be winched through the main pipe to the service connection. The robotic device, together with a television camera, will be used to position the pressure apparatus' inversion elbow at the service connection opening. Air pressure, supplied to the pressure apparatus through an inversion hose, will be used to invert the wet-out liner through the lateral pipe to the cleanout/access/termination point or "Right of Way/easement" line. The inversion head will be adjusted to be of sufficient pressure to cause the impregnated liner to invert completely in the lateral pipe and hold the liner tight to the pipe wall. Care will be taken during the curing process so as not to overstress the liner.

14. Curing – Unless otherwise approved by the engineer, an ambient-temperature curing resin system will be utilized.

Initial Cure will be deemed to be completed when inspection of the exposed portions of the CIPPLL appear to be hard and sound. The cure period will be of a duration recommended by the resin manufacturer, as modified for the installation process.

15. Cooling Process - The pressure shall be increased to compensate for the heating-cooling transition and it shall be maintained until the temperature at the lowest critical point

is 100º F (38º C). This shall constitute completion of the Lateral Liner pipe processing. The pipe within the pipe shall be tight fitting and adapted to the existing sewer pipe.

16. Finish - The reconstructed pipe shall be free of all visual and material defects except those resulting from pre-lined conditions (such conditions shall be brought to the attention of the Owner prior to lining). There shall be no pits, pinholes, cracks or crazing. The surface shall be smooth and create a smooth and watertight connection to the existing pipe by the end of the repair. Any defects that will affect the structural integrity of the reconstructed pipe shall be repaired or the liner will be replaced at the Contractor's expense. This continuous one-piece structural pipe will not inhibit the closed-circuit-television (CCTV) post video inspection of the main or service lateral pipes.

17. Documentation - The submittal shall meet the criteria specified elsewhere in these specifications.

18. Backfill - At all points where the liner pipe has been exposed (such as service connection fittings, or other points where the old pipe must be removed), the liner pipe and fittings shall be encased in cement-stabilized sand or other high density material as specified by the Owner to prevent deflection due to difference in subsidence.

After the encasement material is in place and accepted by the Owner's representative, backfill is placed and compacted to require finish grade in accordance with the Owner's specifications. Particular care should be taken to ensure compaction of earth beneath the lateral pipe in order to reduce subsidence and resultant bending at the lateral connection at the sewer main.

19. Cleanup - After the installation work has been completed and all testing acceptable, the Contractor shall clean up the entire project area and return the ground cover to grade. All excess material and debris not incorporated into the permanent installation shall be disposed of by the contractor. Sidewalk, driveway and street surfaces shall be recovered under the appropriate pay item.

9.04 MEASUREMENT AND PAYMENT

A. Measurement for the CIPP Lateral Connection Liner (EA) shall be per each connection installed and shall include the connection into the mainline as well as the first 3 feet of the lateral measured from the connection to the mainline sewer.

B. Measurement of CIPP Lateral Liner pipe shall be by the linear foot (LF), not including the first 3 feet of the service lateral connection liner paid above, until the termination of the liner.

C. Payment for CIPP Lateral Liner shall include full compensation for all incidental labor, equipment, and materials necessary to complete the work as specified and no additional compensation will be made therefore.

All traffic control required for the trenchless pipe work shall be incidental, with no separate compensation given.

Payment for any repair work to remove line obstructions for the installation of the liner shall be incidental to the liner work with no separate compensation given.

Pre-lining and post-lining televising inspections shall be incidental to the sewer lining work with no separate compensation given.

All items part of section 9.00 are to be fully guaranteed by the Contractor for a period of 2 years from the date of Final Acceptance unless otherwise stipulated in writing y the Owner prior to the date of Conditional Acceptance. During this period, all serious defects discovered by the Owner or Engineer will be removed and replaced by the Contractor in a satisfactory manner at no cost to the Owner. In addition, the Owner may conduct independent televised inspections, at its own expense, of the lining work at any time prior to the completion of the guarantee period.