

2020
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 a hydraulically propelled high-velocity jet cleaner. 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.

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 dispose of this material.

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 seating of the packer or could prevent the proper application of chemical sealants 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.

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 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 (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 sealed.

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 sealed.

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 sealed.

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 2 psi within 15 seconds (due to joint leakage), the joint will have failed the test and shall be sealed.

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 leakage rates of 1/4 gallon per minute or more, 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, 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.

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 manhole section designated to be joint sealed, it shall be the responsibility of the Contractor to clean the sewer line as specified.
2. 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.

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.

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 manhole sections will be selected by the Engineer. Manhole 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 an 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.

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.

SECTION 7.00 - TRENCHLESS PIPE RELINING

7.01 GENERAL REQUIREMENTS

A. Intent.

It is the intent of this specification to provide requirements for all design, materials, transportation, equipment, and labor necessary to reconstruct deteriorated sections of the sanitary sewer listed in these contract documents by means of the cured-in-place pipe process (Insituform), the polyvinylchloride (PVC) pipe fold-and-form process (Nu-Pipe), or the high density polyethylene (HDPE) pipe fold and form process (U-Liner) or approved equal.

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.

- D-1784 Specification for Rigid Polyvinylchloride (PVC) Compounds and Chlorinated Polyvinylchloride (CPVC) Compounds
- D-3034 Specification for Type PSM Polyvinylchloride (PVC) Sewer Pipe and Fittings
- D-1248 Specification for Polyethylene Plastics Molding and Extrusion Materials
- D-1693 Test for Environmental Stress-Cracking of Ethylene Plastics
- D-2837 Obtaining Hydrostatic Design Basis for Thermo-Plastic Pipe Material
- D-3350 Specification for Polyethylene Plastics Pipe and Fittings Materials
- F-714 Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter (3" IPS and larger)
- F-1216 Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube

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 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 or fold-and-form pipe shall be designed to support hydraulic, soil, and live loads.

A copy of the calculations used for the design of the pipe liner shall be submitted to the Engineer prior to fabricating of the pipe liner. Standard formulas as used in the design of flexible pipes shall be used for the design calculations. Height of water over the pipe shall be considered as 10 feet and a Factor of Safety of 2.0 shall be used in all calculations.

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.

The Contractor shall certify that the completed pipe liner shall have a minimum of the full flow capacity of the original pipe before rehabilitation. 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 or water), 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 (Insituform)

1. The tube material and design considerations shall meet the requirements of ASTM F1216, Section 5.1 and modified as follows (or current ASTM standards).
2. The tubes shall have a uniform thickness that when compressed at installation pressures will equal the specified nominal tube thickness.
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 Insitupipe.
5. The resin system shall meet the requirements of ASTM F1216.
6. A certificate of compliance with these specifications shall be provided to the Engineer prior to manufacturing the pipeliner.

B. PVC Fold-and-Form Pipe (Nu-Pipe).

1. PVC Materials: PVC fold-and-form pipe shall meet the performance requirements of ASTM D3034.

The PVC compound used for the folded pipe shall conform to ASTM D1784 classification 12334B, 12344B or 12454 B or C. Compounds that have different call classifications because one or more properties are superior to those of the specified compounds also acceptable. A Certificate of Compliance with this specification shall be provided to the Engineer prior to manufacturing the pipeliner.

C. HDPE Fold-and-Form Pipe (U-Liner).

1. U-Liner Pipe: The HDPE fold-and-form pipe shall be manufactured from high density polyethylene pipe compound which conforms to ASTM D-1248 and meets the requirements for Type PE 34, Class C Product. The installed pipe properties shall also meet these ASTM testing standards.
2. Pipe made from this must have a long-term hydrostatic strength rating of 1600 psi or more, in accordance with ASTM D-2837.
3. When the environmental stress crack resistance (ESCR) of the compound is measured in accordance with ASTM D-1693, Condition C, the compound shall withstand not less than 192 hours in 100% solution Igepal CO-630 at 100° F before reaching a 20% failure point (F20).

4. The U-Liner Pipe shall conform to the minimum structural standards, as listed below:

U.S. Standard		Results
Flexural Stress (Yield)	ASTM D-638	3,300 psi
Flexural Stress (Break)	ASTM D-638	4,500 psi
Modulus of Elasticity **	ASTM D-790	136,000 psi

**Modulus of Elasticity shall not exceed 200,000 psi

5. 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 to the Engineer prior to manufacturing the pipeliner.

7.03 INSTALLATION

A. Incidental Items.

1. 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.

2. Traffic Control - Traffic control shall be the responsibility of the Contractor and shall conform to 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.

3. 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.

4. 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.

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

6. 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.

7. Inspection of Pipelines - 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 pipeliner into the pipelines 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 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.

8. 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 incidental to the installation of the pipeliner.

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.

9. Service Connections - After the pipe has been reconstructed and tested, all existing service connections shall be reconnected. The reconnection of services shall be done without excavation, unless otherwise specified by the Engineer; this will be accomplished from the interior of the pipeline by a television-camera-directed cutting device. All re-cut service connections shall be free of burrs and frayed edges, or any restriction preventing free wastewater flow. Location of the service shall be made by inspection of the pre-construction TV tape and other proven detection methods.

10. 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 that will affect the structural integrity of the reconstructed pipe shall be repaired or the pipeliner will be replaced at the Contractor's expense.

11. 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.

12. 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.

13. Sealing Liner at Manholes - If the liner fails to form a tight seal due to broken or misaligned pipe at the manhole wall, the installer shall apply a seal at that point.

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

B. Installation of Cured-in-Place Pipe, CIPP (Insituform)

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 tube impregnation shall be sufficient to fill the volume of air VOIDS in the tube 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 tube. A roller system shall be used to uniformly distribute the resin throughout the tube.

The resin shall be cured by circulating hot water within the tube or other method approved by the Engineer. When cured, the finished Insitupipe will be continuous and tight fitting.

Temperature gauges shall be placed to determine the temperature of the incoming and outgoing water from heat source. Another such gauge shall be placed inside the tube at the remote end to determine the temperature at that location during the cure cycle.

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

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

b) Leakage testing of the Insitupipe 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

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

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

C. Installation of PVC Fold-and-Form Pipe (Nu-Pipe).

The spool of folded pipe shall be heated to make it flexible, so that it may be bent for insertion into the existing pipe without crimping, kinking, over-straining, or scoring the folded pipe against the existing structures.

A cable shall be strung through the existing pipe and attached to the folded pipe. It shall then be pulled through the existing pipe to the terminating end.

After it is fully inside the pipe, the folded pipe shall be cut off at the starting point and restrained at the terminating point. It shall then be rounded manually at the terminating points and steel (or non-plastic) manifold pipes banded to it as required for the processing. Heat in the form of steam shall be continually applied. The rounding shall be performed in stages as required by the material properties and the licensor procedures.

The Contractor shall submit the details of the proposed processing, including the steps, the pressure (specified steam, air, or water), the duration, and the temperatures.

When processing at temperatures near the melting temperature, the Contractor shall demonstrate how the folded pipe 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.

The rounding shall begin when the temperature of the material reaches a range of 185 degrees to 210 degrees F. The rounding device shall be inserted into the manifold and by use of steam pressure, the rounding device shall be forced through the pipe, rounding it in a progressive manner. In this way extraneous water shall be progressively moved to the terminating end and dimples will be formed at all branch connections. When rounding is complete, air pressure will replace steam as the heat is removed. Water may be added while maintaining the air pressure to cool the pipe to ambient temperature.

The Contractor shall furnish all equipment and personnel to conduct an acceptance test using low pressure air. The test will be conducted under the supervision of the Engineer.

D. Installation of HDPE Fold-and-Form Pipe (U-Liner)

1. Insertion - The U-liner shall be inserted into the existing sewer line with a power winch and steel cable attached to the end of the liner by use of any appropriate pulling head. Length of the liner to be inserted at any one time shall be governed by the winch

drum capacity and winching power available and consideration of the size and condition of the sewer.

2. Processing - A mobile installation unit shall be brought to the site ready to process the liner. The installation unit shall contain the instrumentation control console, steam generating equipment, CCTV facility, and other auxiliary miscellaneous equipment necessary for controlling processing of the U-Liner pipe.

The equipment shall be positioned next to the point of entry with minimum obstruction to the other site activities and shall be operated by trained personnel only.

3. 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 100° F (38° C). This shall constitute completion of the U-Liner pipe processing. The pipe within the pipe shall be tight fitting and adapted to the existing sewer pipe.

4. Testing - The Contractor will, on requirement, furnish all equipment and personnel to conduct an acceptance test using low pressure air. The test will be conducted under the supervision of the Engineer.

7.04 MEASUREMENT AND PAYMENT

A. Measurement of sewer lining pipe shall be by the linear foot measured to the nearest foot between centers of manholes.

B. Payment for sewer lining pipe by the linear foot for each specified 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.

Payment for any repair work to remove line obstructions for the installation of the pipeliner shall be incidental to the sewer lining work with no separate compensation given. This repair work may include the removal and replacement of asphalt pavement, concrete curb and gutter and sodding in addition to the performance of the work to repair the existing sanitary sewer. Any asphalt pavement disturbed by sewer repair work shall be replaced with the City standard pavement section for residential roadways (see Standard Detail Plates at the back of this Manual).

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

SECTION 8.00 - TRENCHLESS PIPE/SHORT-LINER

8.01 GENERAL REQUIREMENTS

A. Intent.

These specifications include requirements for all design, materials, transportation, equipment, and labor necessary to reconstruct deteriorated sections for the sanitary sewer listed in these Contract Documents by means of the Short-Liner process or approved equal.

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.

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.

Short-Liner is manufactured from a polyester felt material which is saturated with a thermosetting resin and inserted into existing sewer line.

1. The installed pipe meets the relevant sections of ASTM F-1216.
2. The Modules of Elasticity for the laminate is minimum value 250,000 psi (ASTM D-790).
3. The Tensile Strength is minimum value 3,000 psi (ASTM D-638).
4. The minimum wall thickness is 8.0 mm, but can vary slightly according to specific installation conditions.

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.

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. Standard dimension ratio of the Short-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.

8.02 MATERIALS

The Modulus of Elasticity is one of the indications of the property of the material. It is in the interest of the Owner to provide a flexible restoration material for the damaged pipe since the condition or the environment in which the pipe is a part obviously is active. The Short-Liner pipe is made of thermosetting material which is designed with the modulus of elasticity range capable of providing the required flexibility without detriment to the structural integrity of the pipe.

The Short-Liner pipe shall conform to the minimum structural standards, as listed below:

	U.S. Standard	Results
Flexural Strength	ASTM D-790	4,500
Modulus of Elasticity	ASTM D-790	250,000

8.03 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. Cleaning of Sewer Line - It shall be the responsibility of the Installer to remove all internal debris from the sewer line (designate cleaning method here to refer to standard sewer cleaning specifications if contained elsewhere in this document).
3. 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 Short-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.
4. 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.

5. 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 Short-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.

6. Insertion - The Short-Liner shall be inserted into the existing sewer line with a power winch and steel cable attached to the end of the liner by use of an appropriate pulling head. Length of the liner to be inserted at any one time shall be governed by the length of the section in need of repair or the maximum length of the installation equipment considering the size and condition of the sewer.

7. Processing - A mobile installation unit shall be brought to the site ready to process the liner. The installation unit shall contain heat generating equipment, CCTV facility and other auxiliary miscellaneous equipment necessary for controlling processing of the Short-Liner pipe. The equipment shall be positioned next to the point of entry with minimum obstruction to the other side activities and shall be operated by trained personnel only.

8. 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 100° F (38° C). This shall constitute completion of the Short-Liner pipe processing. The pipe within the pipe shall be tight fitting and adapted to the existing sewer pipe.

9. 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 Short-Lining). There shall be no pits, pinholes, cracks or crazing. The surface shall be smooth and create a smooth 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 Short-Liner will be replaced at the Contractor's expense.

10. Service Connections - After the pipe has been reconstructed, existing service connections in the repaired section shall be reconnected. The reconnection of services shall be done without excavation, unless otherwise specified by Owner; this will be accomplished from the interior of the pipeline by a television camera directed cutting device. All re-cut service connections shall be free of burrs and frayed edges, or any restriction preventing free wastewater flow. Location of the service shall be made by inspection of the pre-construction TV tape and other proven Short-Lining detection methods.

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

12. 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.

13. 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.

8.04 MEASUREMENT AND PAYMENT

A. Measurement of Short-Liner pipe shall be by the linear foot.

B. Payment for Short-Liner pipe by the linear foot for each specified 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 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.

SECTION 9.00 - 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.

9.01 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 camera will have measurement devices 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.

9.02 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 inspection of the sewer is impaired, 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.

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.

9.03 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. Two copies of each video, in certified PACP format, on a DVD data disk containing all video, print reports and still photos will be provided to the City.

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

Title and ownership of the DVD 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 DVD.

DVD's 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.

9.04 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.