CITY OF FARGO SPECIFICATIONS
PIPE AND MANHOLE REHABILITATION

PART 1
DESCRIPTION OF WORK

The work to be done under this section of the Specifications and the accompanying plans shall include all labor, materials, and equipment necessary to provide for the reconstruction or rehabilitation of pipes and manholes.

The rehabilitation of the sanitary manholes shall be by means of a restorative liner specifically designed for sanitary sewer manholes.

When flow though the sewer cannot be maintained during the course of the work, sewer flows shall be bypassed in accordance with Section 1200 of these Specifications.

PART 2
MATERIAL

2.1. CURED IN PLACE SEWER PIPE (CIPP)

A resin impregnated flexible tube is inverted into the existing pipe utilizing a hydrostatic head, air pressure, or other approved method. The tube shall then be cured to form a hard impermeable pipe. When cured, the liner shall extend over the designated length of the existing pipe in a continuous tight fitting watertight pipe-within-a-pipe. The CIPP shall be fabricated from materials which, when cured, shall be chemically resistant to withstand internal exposure to the type of fluid to be carried by the pipe.

2.1.1. TUBE

The tube shall meet the requirements of ASTM F216 Section 5.1 and should consist of one or more layers of flexible needled felt or an equivalent nonwoven or woven material, capable of carrying resin, withstanding installation pressures and curing temperatures. The tube shall be compatible with the resin system used. The material shall be able to stretch to fit irregular pipe sections and negotiate bends. The outside layer of the tube shall be plastic coated with a material that is compatible with the resin system used. The tube shall be fabricated to a size that, when installed, will tightly fit the internal circumference and length of the original conduit. Allowance shall be made for circumferential stretching during the installation process.

2.1.2. RESIN

The resin shall be a general purpose, unsaturated, styrene based, thermoset resin and catalyst system or an epoxy resin and hardener that is compatible with the inversion process being used. The Resin shall meet the requirements of ASTM F1216 and the following requirements. The resin must be able to cure in the presence of water and the initiation for cure shall be less than 180° F (82.2° C).

2.1.3. STRENGTH

The CIPP shall conform to the following minimum structural standards:

Cured In Place Pipe	**Standard**	**Result**
Tensile Stress	ASTM D-638	3,000 PSI
Flexural Stress	ASTM D-790	4,500 PSI
Modulus of Elasticity	ASTM D-790	250,000 PSI

2.1.4. MINIMUM THICKNESS

The CIPP shall conform to the following minimum thickness standards:

Pipe Size	Thickness required with 250,000psi Modulus of Elasticity	Thickness required with 400,000psi Modulus of Elasticity
8" pipe	0.178 inches	0.153 inches
10" pipe	0.229 inches	0.196 inches
12" pipe	0.359 inches	0.332 inches

2.1.5. MINIMUM THICKNESS

The CIPP shall be designed as per ASTM F1216, Appendix XI. The CIPP design shall assume no bonding to the original pipe wall. The long term Flexural Modulus used in the design shall be verified by independent testing. Such long term Modulus values shall not exceed 50% of the short-term values given in Section 2.3 above. The CIPP thickness shall not be less than those shown above in Section 2.4 for the given physical properties.

2.2. HIGH DENSITY POLYETHYLENE PIPE (HDPE)

2.2.1. MATERIAL

The liner pipe shall be made of a polyethylene pipe compound that meets the requirements of Type III, Grade P34 polyethylene material as defined in ASTM D-1248. The outside diameter and minimum wall thickness shall conform to an SDR of 32.5 when measured in accordance to ASTM D-2122.

2.2.2. SIZE

The size of pipe to be used shall be as shown on the plans.

2.2.3. STRENGTH

When the environmental stress cracking resistance (ESCR) of the material is measured in accordance with ASTM D-1693, the material shall withstand not less than 100 hours in 25 percent solution IGEPAL CO-630 or 1,000 hours in 100 percent IGEPAL CO-630 before reaching a 50 percent failure point (F_{50}).

The polyethylene pipe shall have a manufacturer's recommended hydrostatic design stress rating of 710 psi based on a material with a 1420 psi design basis determined in accordance with ASTM D-2837, Standard Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials.

Workmanship shall be of the highest level compatible with current commercial practice. The PE pipe shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions, or other injurious defects. It shall be uniform in color, opacity, density and other physical properties.

Marking on the pipe shall include the following at intervals of not more than five feet:

1. Nominal pipe size.

2. The type of plastic material, i.e., P.E. 3406.

3. The standard thermoplastic pipe dimension ratio (SDR) or Schedule number.

4. Manufacturer's name or trade mark and code.

Tests for compliance with this specification shall be made as specified herein and according to the applicable ASTM specification. A certificate of compliance with this specification, along with a report of each test, shall be furnished by the manufacturer for all material furnished under this specification.

1. Tensile Properties

The tensile strength, yield strength, elongation and elastic modulus of the material shall be determined in accordance with ASTM D-683. ASTM D-638 shall be used to determine that the thermal butt-fusion joints are stronger than the materials joined.

2. Melt Index

The melt index of the polyethylene resin shall be determined in accordance with ASTM D-1238 and shall be equal, or between 0.1 g/10 min. and 1.0 g/10 min.

3. Density

The density of the base polyethylene resin shall be determined in accordance with ASTM D-1505 and be equal or between .941 g/cc and .955 g/cc.

4. Environmental Stress Cracking Resistance

The material shall be tested in accordance with ASTM D-1693. The test reagent shall be IGEPAL CO-630 in 25 percent solution by volume. The specimens shall be in the solution not less than 100 hours before a 50 percent failure point (F 50).

5. Rejection

Polyethylene pipe may be rejected for failure to meet any of the requirements of this specification.

6. Sustained Pressure

The pipe shall not fail, balloon, burst or weep as defined in ASTM D-1598 when tested in accordance with ASTM D-2239.

2.3 MANHOLE RESTORATION

2.3.1. MANHOLE RELINER - STEP ONE (MORTAR)

2.3.1.1. THICKNESS OF MORTAR

The restorative liner material shall be specifically designed for the rehabilitation of manholes and other related structuresand be compatible with the type of fluid and gases expected to be present in the manhole. Liner materials shall be mixed with water as per manufacturer's written specifications and applied using equipment specifically designed for either low pressure spray or centrifugal spin casting application of cement mortars. All cement liner materials must be capable of a placement thickness of ½" to 4" in a monolithic application. All mortars shall be transported to the construction site in original manufacturer's bags (not less than 50# each).

2.3.1.2. STRENGTH OF MORTAR

Restorative liner materials shall be cement based, and contain microsilicia, thermoplastic fibers, densifiers, polymer admixtures and other modifiers that produce a high strength, low shrinkage and low permeability mortar. Mortar shall not contain calcium aluminate cements or aggregates.

All restorative liner materials shall conform to the following 28-day minimum physical properties:

A. Compressive Strength (ASTM C 109): 6000 psi
B. Tensile Strength (ASTM C109): 575 psi
C. Flexural Strength (ASTM C 78): 985 psi
D. Shrinkage (ASTM C 157): 0.04%
E. Uniaxial Tensile Bond Strength (ACE 503R Appendix A): >500 psi over high strength concrete; 150 psi minimum acceptable bond

Approved manufacturer: Mainstay ML-72 Sprayable Microsilicia Cement Mortar or approved equal.

2.3.2. MANHOLE RELINER - STEP TWO (EPOXY COATING)

The epoxy coating shall be 100% Solids, 2 component, modified epoxy coating with a gloss finish. The epoxy coating shall be capable of application to restorative liner material immediately after the liner has been sprayed, troweled and sponge finished (while restorative liner is in a soft, uncured state).

The epoxy coating shall be off white in color. The epoxy coating shall be capable of being applied in one or two coats. The epoxy shall be applied at a minimum of 50 mils.

Epoxy thickness shall be no less than a uniform 50 mils. If additional epoxy is required at any level, the rotating applicator head shall be placed at that level and application shall commence until that area is thickened.

Approved manufacturer: Mainstay DS-5 Ultra High Build Epoxy Coating or approved equal.

PART 3
CONSTRUCTION

3.1. CURED IN PLACE PIPE (CIPP)

The following installation procedures shall be adhered to unless otherwise approved by the Engineer:

3.1.1. SAFETY

The installer shall carry out his operations in strict accordance with all OSHA and manufacturers safety requirements. Particular attention is drawn to those safety requirements involving working with scaffolding and entering confined spaces.

3.1.2. CLEANING OF PIPES AND OBSTRUCTIONS

Prior to installation, the Contractor shall clean the line that is to receive the liner. It shall be the responsibility of the installer to clear the pipe of obstructions such as solids, protruding service connections, or collapsed pipe that could prevent insertion of the liner or adherence to the pipe wall. If inspection reveals an obstruction that cannot be removed by conventional pipe cleaning equipment, the Contractor shall make a point repair excavation to remove or repair the obstruction. Such excavation shall be approved in writing by the Engineer prior to the commencement of the work and shall be considered as a separate pay item.

3.1.3. INSPECTION OF ORIGINAL PIPE

Inspection of the original pipe shall be performed by experienced personnel trained in locating breaks, obstacles and service connections by closed circuit television or man-entry. The interior of the pipe shall be carefully inspected to determine the location of any conditions that may prevent the proper installation of the liner. A videotape and log noting all services and defects shall be submitted to the Engineer for future reference.

3.1.4. RESIN IMPREGNATION

The tube should be vacuum-impregnated with resin (wet-out) under controlled conditions. The volume of resin used shall be sufficient to fill all voids in the tube

material at nominal thickness and diameter. The volume shall be adjusted by 5-10% excess resin for the change in resin volume due to polymerization and to allow for any migration of resin into the cracks and joints in the original pipe.

3.1.5. NOTIFICATION

The Contractor shall notify all parties who will be affected by the lining operation. For sanitary sewers, the notice shall advise against water usage until the lateral is reconnected and the sewer back in service.

3.1.6. INSTALLATION OF THE LINER

The Contractor shall designate a location where the uncured resin in the original containers and the unimpregnated tube will be vacuum impregnated prior to installation. The installer shall allow the Engineer to inspect the materials and “wet out” procedure. A resin and catalyst system compatible with requirements of this method shall be used. The quantities of the liquid thermosetting materials shall be per manufacturer's standards to provide the wall thickness specified.

3.1.7. INVERSION

The wet out tube shall be inserted through an existing manhole or other approved access by means of an inversion process and the application of a hydrostatic head, air pressure or mechanical means sufficient to fully extend the tube to the next designated manhole or termination point. The tube shall be inserted into the vertical inversion standpipe or guide chute with the impermeable plastic membrane side out and attached with a leak proof seal. The hydrostatic head or air pressure shall be adjusted to cause the impregnated tube to invert from the point of inversion to the point of termination, turning the tube inside out and holding the tube tight to the wall, producing dimples at lateral connections. Care shall be taken to avoid overstressing the fabric. The tube manufacturer shall provide information on the maximum allowable tensile stress for the tube.

Before the inversion begins, the tube manufacturer shall provide the minimum pressure required to hold the tube tight against the existing conduit and the maximum allowable pressure so as not to damage the tube. Once the inversion has started, the pressure shall be maintained between the minimum and maximum pressures until the inversion has

been completed. If the pressures are not maintained, the tube shall be removed from the pipe.

3.1.8. LUBRICANT

The use of a lubricant during inversion shall be used to reduce friction during inversion. The lubricant shall be a nontoxic, oil-based product that has no detrimental effect on the tube, does not support bacteria growth or affect the general characteristics of the fluid to be carried by the pipe.

3.1.9. CURING

After inversion has been completed, the inversion water shall be uniformly raised above the temperature required to effect a cure of the resin as recommended by the manufacturer. The inversion water shall be recirculated by means of a pump throughout the tube and temperature monitors shall be placed on the ingoing and outgoing lines to determine that the correct temperature is maintained. Additionally a temperature gauge shall be installed between the tube and the pipe invert at the termination point to determine temperatures during cure.

If steam is used to cure the tube, the temperature within the tube shall be uniformly raised by means of steam generating equipment. Temperature gauges shall be placed on the outgoing line and also gauges shall be placed between the tube and invert of the existing pipe at both the upper and lower ends of the pipe to determine the temperature during cure.

The recommended temperature shall be held for the length of time recommended by the resin manufacturer. Initial cure occurs during heat up and is indicated when the exposed portions of the tube appear to be hard and sound and the remote temperature sensor(s) indicate that the temperature is of a magnitude to realize an exotherm or cure in the resin. The temperature should then be raised to post cure temperatures and held for the duration recommended by the resin manufacturer.

Pressure shall be maintained as per the manufacturer's recommendations to hold the flexible tube tight against the existing pipe. This pressure shall be maintained until the cure has been completed.

The Contractor shall provide a continuous log of the designated temperatures and pressures during the time of the cure. The Contractor shall also furnish the Engineer with the resin manufacturers recommended cure temperatures and pressures prior to the start of the inversion process.

3.1.10. COOL DOWN

The liner pipe shall be cooled down to a temperature below 100º F (113º F for steam cured) before relieving the internal pressure. Cool down may be accomplished by introducing cool water into the section as the water and/or steam is drained off through a small hole in the downstream end. Care must be taken to avoid causing a vacuum that could damage the newly installed pipe.

3.1.11. FINISH

The finished CIPP shall be continuous over the entire length between manholes and be free from visual defects such as foreign inclusions, dry spots, lifts, pinholes or delamination. The new pipe shall be free of leaks and any defects that will affect the integrity or strength of the CIPP shall be repaired at the Contractor's expense in a manner acceptable to the Engineer.

3.1.12. SEALING CIPP AT MANHOLES

Hydrophilic seals shall be used to achieve a watertight connection at manholes. If the CIPP fails to make a tight seal at the manhole walls the Contractor shall apply a resin mixture seal at that point. The resin seal shall be compatible with the resin mixture of the CIPP.

3.1.13. SERVICE CONNECTIONS

After the new pipe has been cured in place, the Contractor shall reconnect all existing active service connections. This shall be done without excavation by means of a television camera and cutting device or by man entry and a cutting device. The services shall be restored to not less than 90% of their original capacity and shall be free of any sharp edges or protrusions, which could cause paper, rags or debris to accumulate.

3.1.14. INSPECTION

Two CIPP samples shall be prepared for each inversion length between manholes. The samples shall be fabricated from material taken from the tube and the resin/catalyst system used. The samples shall be clamped between flat plates and the mold placed in the downtube when circulating water is used or in the silencer when steam is used. The samples shall be large enough to provide a minimum of five specimens for flexural and tensile testing. After curing, the samples will be submitted to an independent testing firm to confirm the finished product meets the requirements of these Specifications.

3.2. HIGH DENSITY POLYETHYLENE PIPE (HDPE)

3.2.1. LINE OBSTRUCTION

Prior to commencing sliplining, the Contractor will clean the line that is to receive the polyethylene liner. It shall become the responsibility of the Contractor to clear the line of any protruding service connections or solids that might prevent the pulling of the lines through the existing sewer. In particular, debris or other materials should be removed from the bottom of the original pipe so that the inserted pipe will not be resting on or against nor be irregularly supported by such materials. Should the liner become jammed while being pulled, the Contractor shall excavate over the point of obstruction to clear the liner.

Immediately before the insertion operation, it may be desirable to pass a test-head of the same diameter as the polyethylene pipe to be inserted through the original pipe to ensure free passageway. Test-heads shall be attached to pulling cables at both ends.

3.2.2. EXCAVATION

Excavation shall conform to the requirements herein set forth, as called for on the drawings or as otherwise approved in writing by the Engineer or his representative.

“Pulling pits” will be required at intermediate manholes or other intermediate points where the liner pipe will be “fed” into the existing sewer. These excavations should be kept to a minimum size and coincide with building service connection excavations or critical deviations in line or grade whenever possible.

3.2.3. HANDLING PIPELINE

Pipe shall be stored on clean level ground to prevent undue scratching or gouging. Sections of pipes with deep cuts or gouges shall be removed completely and the ends of the pipeline rejoined. The handling of the joined pipeline shall be in such a manner that the pipe is not damaged by dragging it over sharp and cutting objects.

Pipe should be inspected for damage immediately prior to joining. Damage will consist of: (1) serious abrasion, cutting, or gouging of the outside surface extending to more than 10% of the wall thickness in depth; (2) kinking due to excessive or abrupt bending; (3) flattening, particularly if localized over short lengths of the pipe amounting to more than 5% of the original diameter; and (4) any abrasion or cutting of the inside surface. Damaged portions should be cut out and discarded. The resulting short lengths may be used as such or rejoined by the butt fusion procedure.

3.2.4. FUSION JOINTING

Joining shall be by the heating and butt-fusion method and in strict conformance with the manufacturer's recommendations and ASTM D-2657. Polyethylene pipe lengths to be fused shall be the same type, grade and class of polyethylene compound and supplied by the same raw material supplier.

Joining of the pipes and fittings shall be performed in accordance with the procedures recommended by the pipe manufacturer. Depending upon the installation requirements and site location, joining shall be performed within or outside the excavation. Joints between pipe sections shall be smooth on the inside and internal projection beads shall not be greater than 3/16 inch. Unacceptable joints shall be cut out and the joint redone.

The tensile strength at yield of the butt-fusion joints shall not be less than that of the pipe. A specimen of pipe cut across the butt-fusion joints shall be tested in accordance with ASTM D-638.

Where excavations for insertion of the polyethylene liner are made in a line section between two manholes, the polyethylene pipe will be joined together with a stainless steel water main repair sewer. The exposed liner and clamp shall then be encased with stabilized sand.

3.2.5. INSERTION OF LINER PIPE

Prior to insertion of the liner pipe, the Contractor shall saw and remove the pavement over the existing services to allow for speedier hookup of the services. The liner pipe shall be pulled into the sewer by use of winches and pulling heads. Pushing of the liner into the sewer will not be allowed.

Where installation of liner pipe is to be in "pulling pits", the existing sewer shall be exposed to springline for the full length of the pit prior to removal of the crown portion of a section of the existing main. The flow line of the existing sewer shall be maintained. Only one pulling pit will be allowed on this project and the location is shown on the plans.

A power winch shall then be connected to the end of the liner by use of a metal pulling head, so the liner can be fed into the existing sewer. Precautions shall be taken not to damage the liner or break any of the joints. It may also be necessary to put guards over the edges of the existing pipe at the inlet end to prevent their gouging the polyethylene pipe during the insertion procedure.

A sturdy pulley frame must be constructed at the base of a manhole or shaft, capable of withstanding the substantial force required to move the pipe being inserted. The winch, usually placed on the surface at the head of the manhole or shaft must usually be powered; but a geared, hand-operated winch may be sufficient for the insertion of small piping. Load controls are desirable to prevent overstressing the equipment in case of a blockage.

When liner pipe of the same diameter is extended into a straight-through manhole, the pipe ends shall be butted against the other liner pipe and the top one-third cut out and a concrete shell poured to match this cut.

Length of the liner pipe to be pulled into an existing sewer at any one time shall be governed by the size of sewer being sliplined and condition of the existing sewer.

3.2.6. ELONGATION

The insertion operation often proceeds with a "slip-stick" action. Particularly when pulling, means of coordinating the feed of pipe into the entrance with operation of the

winch is desirable. The pulling operation will tend to stretch the pipe, and excessive stretching (more than 1.5%) should be avoided. The pulling speed is unlikely to exceed about 300 mm/s (1 ft/s), and slower speeds will be necessary under the more difficult conditions. Once started, the operation should continue without interruption until completed.

On reaching the exit point, the pipe should be pulled beyond this point as advised by the coordinator, at the entrance point. Stretching of about 1% of the total length pulled will often be observed. This stretching will be recovered over a period of time about equal to the length of time it took to complete the pull. If the work is done during warm weather, an additional contraction may also be observed. This can be as much as 20 mm/30 m-5°C (1 in./100 ft-10°F) difference in temperature between the pipe before and after installation and this should be allowed for in the length of insertion pipe used.

When stabilization is complete, anchoring and grouting can be done.

3.2.7. SERVICE CONNECTIONS

After the liner has been pulled into place and secured in the manhole walls, each existing service connection shall be reconnected to the new liner in accordance with the Specifications. A portion of the existing sewer around each service connection shall be removed to expose the liner pipe and provide sufficient working space for making the new service connection.

Service connections shall be made with the use of PVC saddle. The liner shall be cut with the use of a template. The connection shall be watertight and the saddle attached to the main with stainless steel ring clamps.

The Contractor shall be responsible for damages caused by plugged or blocked sewer services. Upon report of a blocked service, the Contractor shall immediately excavate down at that service to alleviate the problem before continuing any other work.

3.2.8. BACKFILL

At all points where the liner pipe has been exposed, as in pulling pits, service connections, outside of manholes, etc., the Contractor shall remove all debris and create a void along each side of the pipe at springline to undisturbed soil, in preparation for gravel

backfill. Width of the void shall not exceed (liner diameter plus 2 feet) or (service diameter plus 2 feet). Controlled density fill shall be placed along the sides and to a point one foot above the liner pipe and level across the trench. Care shall be exercised at all times to prevent damage or collapse to the polyethylene liner, service connections, etc. Should the bottom be unstable, the Contractor shall use compacted pea gravel to the bottom of the liner pipe.

After the controlled density fill is in place and accepted by the Engineer, gravel backfill under streets and excavated material under boulevards shall be placed and compacted to finished grades in accordance with the Specifications.

3.3. MANHOLE RESTORATION

3.3.1. MANHOLE PREPARATION

The floor and interior walls of the manhole shall be thoroughly cleaned and made free of all foreign materials including dirt, grit, roots, grease, sludge and all debris or materials that may be attached to the wall or bottom of the manhole. A high pressure wash with a minimum pressure of 4500 psi shall be used to clean and free all foreign material within the manhole. When grease and oil are present, an approved detergent shall be used integrally with the high pressure cleaning water. All materials resulting from the cleaning of the manhole shall be removed prior to application of the restorative liner. All loose or defective brick, grout, ledged, steps and protruding ledges shall be removed to provide an even surface prior to application of cement based coating.

3.3.2. SEALING ACTIVE LEAKS FOR MANHOLE RELINER

If active leaks are detected prior to placement of the restorative liner, hand apply a dry quick-setting cement based mix designed to instantly stop running water or seepage. The applicator shall apply material in accordance with manufacturer's recommendations and following specifications:

A. The area to be repaired must be clean and free of all debris.
B. Once cleaned, prepare crack or hole by chipping out loose material to a minimum depth and width of ¾ inch.

C. With gloved hand, place a generous amount of the dry quick-setting cement based material to the active leak, with a smooth fast motion, maintaining external pressure for 30 seconds, repeat until leak is stopped.

D. Proper application should not require any special mixing of product or special curing requirements after application.

3.3.3. MANHOLE RELINER APPLICATION - STEP ONE (MORTAR)

Material shall be mixed with water in accordance with manufacturer's specifications. Once mixed to proper consistency, the materials shall be pumped via a rotor-stator style progressive cavity pump through a hose.

Material hose shall be coupled to a high speed rotating applicator device. The rotating applicator shall then be positioned within the center of the manhole at either the top of the manhole chimney or the lowest elevation at the junction of the manhole bench and walls.

The high speed rotating applicator shall then be started and material pumping shall commence. As the mortar begins to be centrifugally cast evenly around the interior of the manhole, the rotating applicator head shall be raised and/or lowered at a controlled retrieval speed to provide a uniform material thickness on the manhole walls.

Controlled multiple passes are made until the specified minimum thickness is achieved. If the procedure is interrupted the applicator head is stopped until flows are restored.

Material thickness may be verified at any point with a depth gauge and shall be no less than 1 inch. If additional material is required at any level, the applicator head shall be placed at that level and application shall commence until that area achieves the specified thickness.

Material shall be applied only when manhole is in a damp state with no visible water dripping or running over the manhole walls.

The low-velocity spray nozzle and the centrifugal spin casting head may be used in conjunction to facilitate uniform application of the mortar material to irregularities in the contour of the manhole walls and bench areas.

Troweling and sponge finishing shall begin immediately following the spray application of the mortar.

3.3.4. MANHOLE RELINER APPLICATION - STEP TWO (EPOXY COATING)

All epoxy coatings shall be designed specifically for the rehabilitation of manholes and other related waste water structures. The epoxy coating shall be designed to be applied to newly placed mortar immediately following the placement (by centrifugal spin casting) and troweling of the mortar. **This process shall begin no more than four hours following placement of the mortar. The mortar must be in a soft, uncured, plastic state.**

Epoxy hose shall be coupled to a high speed rotating applicator device. The rotating applicator shall then be positioned within the center of the manhole at either the top of the manhole chimney or lowest elevation at the junction of the manhole bench and walls.

The high speed rotating applicator shall then be started and pumping of the epoxy shall begin. As the epoxy begins to be centrifugally cast evenly around the interior of the manhole, the rotating applicator head shall be raised and/or lowered to provide a uniform epoxy thickness on the manhole walls.

Controlled multiple passes are then made until the specified minimum thickness is attained. If the procedure is interrupted for any reason, stop the applicator head until flows are recommenced.

Curing will take place once the manhole cover has been replaced. Plastic sheeting is installed below the manhole lid so the lid does not bond to the structure. The plastic sheeting also prevents foreign objects from embedding in the fresh epoxy.

PART 4
GUARANTEE, MEASUREMENT & PAYMENT

4.1. GUARANTEE

The guarantee shall be per the contract.

4.2. MEASUREMENT AND PAYMENT

4.2.1. CURED IN PLACE PIPE

The CIPP will be paid on the actual number of feet of the various sizes of liner installed, as measured along the centerline of the existing pipe between the manholes or to the ends of the liner installed. Payment shall include furnishing and installing the liner, curing, sealing at the manholes, cleaning and televising, bypassing of sewage, insertion equipment and all incidentals required to reline the existing pipe in place and accepted.

4.2.2. SEWER SERVICE RECONNNECTION

All costs of making sewer service reconnections shall be included in the contract unit price for Reconnect Sewer Service.

4.2.3. CLEANING AND TELEVISING

Cleaning and televising costs shall be included in the contract unit price for the pipe being rehabilitated.

4.2.4. PUMPING SEWAGE

All costs associated with the bypassing of sewage shall be included in the contract unit price for the pipes or manholes being rehabilitated.

4.2.5. HIGH DENSITY POLYETHYLENE PIPE (HDPE)

The quantity to be paid for shall be the actual number of linear feet of liner pipe installed, as measured along the centerline of the existing main between manholes or to ends of liner installed. Payment for slipliner pipe shall include furnishing and installing liner piping, thermal jointing, circle seal clamping, manhole sealing, sewer cleaning, pulling equipment, bypassing sewage, televising, and all other incidentals required to slipline an existing main complete in place and accepted.

4.2.6. PULLING PITS

All costs for providing pulling pits shall be included in the contract unit price per linear foot of HDPE liner pipe. The pavement removal, gravel backfill and pavement replacement will be paid for at contract unit prices.

4.2.7. LINE OBSTRUCTION

All work done to clear a jammed liner during pulling will be considered incidental to the contract and no extra payment shall be made. The pavement removal, gravel backfill and pavement replacement will be paid for at contract unit prices.

4.2.8. DEWATERING

Except where a bid item exists, all costs for any necessary dewatering shall be included in the price bid for other items.

4.2.9. MANHOLE RESTORATION

All costs associated with manhole restoration shall be paid at the contract unit price per linear foot for Manhole Liner. The measurement shall be from the manhole floor to the top of the liner.