



STANDARD SPECIFICATIONS

(INFLOW AND INFILTRATION)

MSD STANDARD I/I SPECIFICATIONS

INDEX

	<u>PAGE</u>
<u>SECTION 1 – CURED-IN-PLACE PIPE</u>	
1.1. General	II 1-1
1.1.1. Description of Work	II 1-1
1.1.2. Reference Standards	II 1-1
1.1.3. Acceptable CIPP Reconstruction Systems/Processes	II 1-2
1.1.4. Contractor Submittals	II 1-2
1.1.5. Contractor Availability	II 1-2
1.1.6. Quality Assurance	II 1-3
1.1.7. Public Notification	II 1-3
1.1.8. Project Documentation	II 1-3
1.1.9. Property Service Connections	II 1-4
1.2. Materials	II 1-4
1.2.1. Cured-in-Place Pipe	II 1-4
1.2.2. Materials Testing	II 1-6
1.3. Execution	II 1-6
1.3.1. General	II 1-6
1.3.2. Preparation	II 1-6
1.3.3. Bypass Pumping	II 1-7
1.3.4. Cleaning and Inspection	II 1-7
1.3.5. Point Repairs	II 1-8
1.3.6. Liner Installation	II 1-8
1.3.7. Curing	II 1-9
1.3.8. Cool-Down	II 1-9
1.3.9. Service Connections	II 1-10
1.3.10. Testing	II 1-10
1.3.11. FELL 41 Test Method	II 1-10
1.3.12. Warranty	II 1-11
<u>SECTION 2 – LATERAL REHABILITATION</u>	
2.1. General II 2-1	
2.1.1. Description of Work	II 2-1
2.1.2. Reference Standards	II 2-1
2.1.3. Acceptable CIPP Reconstruction Systems/Processes	II 2-1
2.1.4. Contractor Submittals	II 2-2
2.1.5. Contractor Availability	II 2-2
2.1.6. Quality Assurance	II 2-3
2.1.7. Public Notification	II 2-3
2.1.8. Project Site Documentation	II 2-3

SECTION 2 – LATERAL REHABILITATION (Continued)

2.2. Materials	II 2-4
2.2.1. Cured-in-Place Pipe	II 2-4
2.2.2. Materials Testing	II 2-5
2.3. Execution	II 2-6
2.3.1. General	II 2-6
2.3.2. Preparation	II 2-6
2.3.3. Bypass Pumping	II 2-6
2.3.4. Cleaning and Inspection	II 2-7
2.3.5. Point Repairs	II 2-8
2.3.6. Liner Installation	II 2-8
2.3.7. Curing	II 2-9
2.3.8. Cool-Down	II 2-9
2.3.9. Service Connections	II 2-9
2.3.10. Cleanouts	II 2-10
2.3.11. Testing	II 2-10
2.3.12. Warranty	II 2-12

SECTION 3 – CHEMICAL GROUTING

3.1. General	II 3-1
3.1.1. Description of Work	II 3-1
3.1.2. Contractor Submittals	II 3-1
3.1.3. Quality Assurance	II 3-1
3.1.4. Public Notification	II 3-2
3.2. Materials	II 3-2
3.2.1. General	II 3-2
3.2.2. Acrylamide Base Gel Sealing Material	II 3-2
3.2.3. Acrylic Base Gel Chemical Sealing Material	II 3-3
3.2.4. Urethane Base Gel Chemical Sealing Material	II 3-3
3.2.5. Urethane Base Foam Chemical Sealing Material	II 3-4
3.3. Execution	II 3-4
3.3.1. General	II 3-4
3.3.2. Preparation	II 3-4
3.3.3. Bypass Pumping	II 3-5
3.3.4. Cleaning and Inspection	II 3-5
3.3.5. Equipment	II 3-6
3.3.6. Joint Sealing Procedure	II 3-6
3.3.7. Joint Sealing Verification	II 3-6
3.3.8. Sewer Pipe Joint Testing	II 3-6
3.3.9. Residual Sealing Materials	II 3-7
3.3.10. Warranty	II 3-7

SECTION 4 – MANHOLE REHABILITATION- MECHANICALLY LOCKING
CHIMNEY SEALS

4.1. General	II 4-1
4.1.1. Description of Work	II 4-1
4.1.2. Contractor Submittals	II 4-1
4.2. Materials	II 4-1
4.3. Execution	II 4-2
4.3.1. General	II 4-2
4.3.2. Project Documentation	II 4-2
4.3.3. Pre-Installation Inspection	II 4-3
4.3.4. Manhole Preparation	II 4-4
4.3.5. Quality Control	II 4-5
4.3.6. Testing	II 4-5
4.3.7. Saturation Test	II 4-6
4.3.8. Warranty	II 4-6

SECTION 5 – MANHOLE REHABILITATION – NON-MECHANICAL
CHIMNEY SEALS

5.1. General	II 5-1
5.1.1. Description of Work	II 5-1
5.1.2. Contractor Submittals	II 5-1
5.2. Materials	II 5-2
5.3. Execution	II 5-2
5.3.1. General	II 5-2
5.3.2. Pre-Installation Inspection	II 5-3
5.3.3. Manhole Preparation	II 5-3
5.3.4. Installation	II 5-3
5.3.5. Testing	II 5-4
5.3.6. Warranty	II 5-5

SECTION 6 – MANHOLE REHABILITATION –
EPOXY COATING

6.1. General	II 6-1
6.1.1. Description of Work	II 6-1
6.1.2. Reference Standards	II 6-1
6.1.3. Contractor Submittals	II 6-2
6.1.4. Applicator Qualifications	II 6-2
6.1.5. Contractor Availability	II 6-3
6.1.6. Project Documentation	II 6-3
6.1.7. Quality Assurance	II 6-3
6.1.8. Safety	II 6-4
6.1.9. Public Notification	II 6-4
6.2. Materials	II 6-4

	<u>PAGE</u>
<u>SECTION 6 – MANHOLE REHABILITATION – EPOXY COATING (Continued)</u>	
6.2.1. Storage and Handling	II 6-4
6.2.2. Existing Products	II 6-4
6.2.3. Repair	II 6-4
6.2.4. Protective Coating	II 6-5
6.2.5. Physical Properties	II 6-5
6.2.6. Equipment	II 6-5
6.3. Execution	II 6-5
6.3.1. Examination	II 6-5
6.3.2. Bypass Pumping	II 6-6
6.3.3. Surface Preparation	II 6-6
6.3.4. Application of Repair Materials	II 6-7
6.3.5. Application of Protective Coating	II 6-8
6.3.6. Testing and Inspection	II 6-8
6.3.7. Warranty	II 6-10
<u>SECTION 7 – MANHOLE REHABILITATION – CAST-IN-PLACE CEMENTITIOUS LINER</u>	
7.1. General	II 7-1
7.1.1. Description of Work	II 7-1
7.1.2. Reference Standards	II 7-1
7.1.3. Contractor Submittals	II 7-1
7.1.4. Contractor Availability	II 7-2
7.1.5. Project Documentation	II 7-2
7.1.6. Safety	II 7-3
7.1.7. Public Notification	II 7-3
7.1.8. Quality Assurance	II 7-3
7.2. Materials	II 7-3
7.2.1. Concrete	II 7-3
7.2.2. Plastic Liner	II 7-4
7.3. Execution	II 7-4
7.3.1. General	II 7-4
7.3.2. Bypass Pumping	II 7-4
7.3.3. Cleaning and Preparation	II 7-4
7.3.4. Equipment	II 7-5
7.3.5. Installation	II 7-5
7.3.6. Testing and Inspection	II 7-5
7.3.7. Warranty	II 7-6
<u>SECTION 8 – MANHOLE REHABILITATION – CURED-IN-PLACE MANHOLE LINER</u>	
8.1. General	II 8-1
8.1.1. Description of Work	II 8-1

SECTION 8 – MANHOLE REHABILITATION –
CURED-IN-PLACE MANHOLE LINER (Continued)

8.1.2. Reference Standards	II 8-1
8.1.3. Contractor Submittals	II 8-2
8.1.4. Equipment	II 8-3
8.1.5. Contractor Availability	II 8-3
8.1.6. Project Documentation	II 8-3
8.1.7. Quality Assurance	II 8-3
8.1.8. Safety	II 8-4
8.1.9. Public Notification	II 8-4
8.2. Materials	II 8-4
8.2.1. CIPM Liner System	II 8-4
8.3. Execution	II 8-6
8.3.1. General	II 8-6
8.3.2. Bypass Pumping	II 8-6
8.3.3. Cleaning and Preparation	II 8-7
8.3.4. Installation	II 8-7
8.3.5. Curing	II 8-8
8.3.6. Testing	II 8-8
8.3.7. Warranty	II 8-9

SECTION 9 – CHEMICAL ROOT CONTROL

9.1. General	II 9-1
9.1.1. Description of Work	II 9-1
9.1.2. Contractor Submittals	II 9-1
9.1.3. Protection of Homes, Waste Water Treatment Plants and Receiving Waters	II 9-1
9.1.4. Compliance with Transportation Laws	II 9-2
9.1.5. Pollution Liability Insurance	II 9-2
9.1.6. Contractor Qualifications	II 9-3
9.1.7. Project Documentation	II 9-3
9.1.8. Substitutes and Proven Equivalents	II 9-4
9.2. Materials	II 9-4
9.2.1. Chemical Root Control	II 9-4
9.2.2. Equipment	II 9-5
9.3. Execution	II 9-5
9.3.1. Sewer Cleaning	II 9-5
9.3.2. Applications	II 9-5
9.3.3. Notifications	II 9-6
9.3.4. Contractor Responsibilities	II 9-6
9.3.5. Television Inspection	II 9-7
9.3.6. Warranty	II 9-7

SECTION 1

MSD STANDARD I/I SPECIFICATION

CURED-IN-PLACE PIPE

1.1. GENERAL

1.1.1. Description of Work

This section covers the work necessary to restore existing sanitary sewers by the installation of Cured-In-Place Pipe (CIPP). CIPP is formed by inverting a resin impregnated flexible tube into the existing sewer line using hydrostatic head and curing with circulating hot water, **air/steam inversions**, or other approved means to produce a hard, impermeable pipe. The CONTRACTOR shall provide all materials, labor, equipment and services necessary for bypass pumping of sewage flows, cleaning, pre-inversion television inspection of sewers to be lined, installation of liner, reconnection of sewer service connections, and final television inspection. This specification represents **minimum** standards and the CONTRACTOR shall abide by any manufacturer specifications that exceed these specifications.

1.1.2. Reference Standards

ASTM F 1216	Standard Practice for Rehabilitation of Existing Pipes and Conduits by the Inversion and curing of a Resin-Impregnated Tube
ASTM D 638	Standard Test Methods for Tensile Properties of Plastics
ASTM D 648	Standard Test Methods for Deflection Temperature of Plastics under Flexural Load
ASTM D 790	Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
ASTM D 2583	Standard Test Methods for Determination of Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor
ASTM D 2990	Standard Test Methods for Tensile, Compressive, and Flexural Creep and Creep Rupture of Plastics
NAASCO	Recommended Specifications for Sewer Collection System Infrastructure Analysis and Rehabilitation Manual
NAASCO	Pipeline Assessment and Certification Program (PACP)

1.1.3. Acceptable CIPP Reconstruction Systems/Processes

The only acceptable Cured-In-Place pipeline reconstruction system/processes for pipe installation work are Insituform, In-Liner, National Liner, or approved equal.

1.1.4. CONTRACTOR Submittals

1.1.4.1. All CONTRACTOR Project Submittals shall be submitted to MSD within **30** days of Notice to Proceed issuance. All submittals must be approved by MSD prior to the start of construction. Required submittals are as follows:

- A. Bypass Pumping Plan – shop drawing showing bypass pumping locations with sufficient detail to assure that the work can be accomplished without sewage spill.
- B. Sample **Customer** Notification
- C. Third Party Testing Laboratory Credentials
- D. Traffic Control Plan including shop drawings and signage in accordance with MUTCD guidelines
- E. Construction calculations for liner size and thickness, including assumptions used in calculations **per latest version of ASTM F1216. Include a schedule of pipe segments.**
- F. Manufacturer Specifications for resins and liner material. **Provide third party laboratory test data showing short/long term physical properties of CIPP system being used.**
- G. Construction Plan including the following submittals; insertion locations **and schedule, Inversion plan complete with lengths of inversions**, material storage location, installation procedures, sampling procedures, project schedule, erosion control plan, **and location of wet-out facility, safety plan, emergency spill plan, chemical safety plan, MSDS sheets, and cleanup plan.**
- H. Manufacturer Specifications for gap filler material (end seal connections) and PSC liner materials.**

1.1.4.2. All submittals shall identify the specification section(s) they address.

1.1.5. CONTRACTOR Availability

1.1.5.1. The PRIME CONTRACTOR shall be on site from the beginning of the inversion until the final PSC has been reconnected.

1.1.5.2. The CONTRACTOR shall have a local or 1-800 cellular phone or pager active at all times.

1.1.6. Quality Assurance

1.1.6.1. The CONTRACTOR shall clean the host pipe, remove all roots, and make any necessary point repairs prior to conducting pre-inversion TVI for submittal to MSD.

1.1.6.2. The finished liner shall be continuous over the entire length of the inversion run between access points and shall be free of visual defects such as wrinkles, bulges, tears, foreign inclusions, cracks, crazing, dry spots, pinholes, or de-lamination.

1.1.7. Public Notification

1.1.7.1. 72 hours prior to disruption of service, the CONTRACTOR shall notify property owners, public, residents, and all others who may be affected using a notification form approved by MSD

1.1.7.2. The CONTRACTOR shall disrupt customer service for no longer than 12 hours. If service will be disrupted for more than 12 hours, the CONTRACTOR must notify affected customers and MSD of the delay.

1.1.8. Project Documentation

1.1.8.1. The CONTRACTOR shall make a walk through **digital** video prior to the start of construction and another immediately after the completion of the project. These videos shall document the condition of the entire project area. The project name, contract number, and the date and time of filming shall be clearly identified in the videos. The location within the project area shall be clearly identified as filming progresses.

1.1.8.2. The CONTRACTOR shall take seven pre-rehab **digital** photos per 100 feet of sewer main detailing the project area.

1.1.8.3. The CONTRACTOR shall **provide the digital** photos **on a CD/DVD** including an index with the following information; corresponding photo number, contract number, street address as appropriate, record drawing number, CONTRACTOR name, location by station, and date.

1.1.8.4. **Digital** videos and **digital** photo **documentation** shall be submitted to the MSD INSPECTOR at the earliest possible date.

1.1.8.5. Upon completion of installation, the CONTRACTOR shall update the final **as-built drawings** to reflect the actual work performed and shall submit the completed **as-built drawings** to MSD or its representative prior to acceptance testing.

1.1.9. Property Service Connections

1.1.9.1. Existing property service connections conflicting with the proposed construction shall be adjusted by the CONTRACTOR. To the extent possible, adjustments shall be

accomplished using remote equipment. Remote equipment necessary to perform **intruding lateral** adjustments shall be considered conventional sewer cleaning equipment.

1.1.9.2. Property service connections that are not in service and are visibly plugged shall be lined through and not re-instated unless directed otherwise by the MSD INSPECTOR. All property service connections that are lined through shall be documented as follows; CONTRACTOR's name, MSD INSPECTOR's name, upstream and downstream manhole, property address, distance from upstream manhole and clock reading. The documentation shall be submitted to the MSD INSPECTOR prior to inversion of the liner.

1.1.9.3. Reinstated property service connections shall **completed using a "top-hat" type or approved equal connection liner to ensure a clean transition from the PSC to the rehabbed pipe. The existing PSC shall** be buffed such that the opening is smooth, circular, and free of burrs or other obstructions. Excess resin from lining shall be the CONTRACTOR's responsibility to remove. Coupons from all reinstatement of property service connections shall be removed from the sewer and disposed of properly.

1.2. MATERIALS

1.2.1. Cured-In-Place Pipe: **The liner tube being installed shall be sized correctly, allowing for stretch, to tightly fit the inside of the existing pipe. A resin and catalyst system that is compatible with the requirements of the method shall be used.**

1.2.1.1. The liner tube shall consist of one or more layers of flexible needle felt or an equivalent woven and/or non-woven material capable of carrying resin, withstanding installation pressures and curing temperatures, and that is compatible with the resin system used.

1.2.1.2. The resin used shall be compatible with the rehabilitation process, shall be able to cure in the presence or absence of water, and the initiation temperature for cure shall be as recommended by the resin manufacturer.

1.2.1.3. The finished lining shall consist of an inner polyurethane layer and an outer polyester/terylene felt layer (or layers) impregnated with a thermosetting polyester resin **(or approved equal)** to fit tight against the inside of the host pipe wall. The liner shall be fabricated from materials that when cured will be chemically resistant to withstand internal exposure to sewer gases containing quantities of hydrogen sulfide, carbon monoxide, methane, petroleum hydrocarbons, saturation with moisture, and dilute sulfuric acid.

1.2.1.4. **The CONTRACTOR shall verify both the lengths and diameters for the tubes before they are manufactured.** The minimum length shall be that deemed necessary by the CONTRACTOR to effectively span the distance from the inlet to the outlet of the respective manholes unless otherwise specified. The CONTRACTOR shall verify **both the lengths and diameters** in the field before the liner is impregnated with resin. Individual inversion runs can be made over one or more manhole sections as determined in the field by the CONTRACTOR and approved by the ENGINEER.

1.2.1.5. Prior to inversion, the liner shall be free of all visible tears, holes, cuts, foreign materials, and other defects.

1.2.1.6. The physical properties of the cured liner **shall be in accordance with ASTM D 790 and ASTM D 638 and** shall have minimum values as follows:

	<u>Polyester Resin</u>	
	<u>Short Term</u>	<u>Long Term</u>
Flexural Strength (psi)	4,500	
Flexural Modulus (psi)	250,000	125,000
Tensile Strength at Yield (psi)	3,000	

1.2.1.7. The liner shall conform to the following:

<u>Parameter</u>	<u>Pipe</u>
Minimum thickness of bonded polyurethane Membrane and inner liner resin content (w/i $\pm 5\%$)	0.25 mm + 5% 85% resin, 15% felt by volume
Thickness	per ASTM F 1216
Hardness	(Barcol) 22 per ASTM D2583
Heat distortion temperature	70°C per ASTM D 648

(CONTRACTOR shall field verify the internal diameter of host pipe prior to sizing liner.)

1.2.1.8. The liner thickness is based on the resin mechanical properties shown in 1.2.1.7. The liner shall have a wall thickness as set forth in ASTM F 1216 and be structurally sound and without joints. The CONTRACTOR shall calculate the wall thickness for a **fully deteriorated pipe and a groundwater depth of 10' above the top of the pipe or to the ground surface, whichever is less.** If the CONTRACTOR uses resins having different mechanical properties, the CONTRACTOR shall submit detailed calculations of the proposed liner thickness **for all pipe segments regardless of resin used** for the approval of the ENGINEER. Calculations shall consider external hydrostatic pressure, static and earth-load pressures and internal, surcharge pressures. The liner shall be sized in accordance with the design parameters shown below:

Design Life:	50 years
Ovality:	6%
Soil Modulus:	1,000 psi
Soil Weight	125 lb/cf
Enhancement Factor:	7
Excess Resin:	The 5% excess resin requirement shall not be used in determining liner thickness. The supplier, however, shall provide excess resin to meet the project specific requirements.

1.2.1.9. The resin used shall not contain fillers except those required for viscosity control. A thixotropic agent in an amount up to 5% by mass may be added for viscosity control.

1.2.2. Materials Testing

1.2.2.1. General: All materials testing shall be performed at the CONTRACTOR's expense and by an independent third party laboratory approved by MSD. The samples shall be taken **in accordance with ASTM F 1216. Additionally, the third party lab shall provide the thickness of each plate sample.**

1.2.2.2. Physical Properties:

1.2.2.2.1. The cured inversion tube shall be sampled and tested for tensile strength, flexural strength, and flexural modulus. Flexural strength and modulus shall be tested in accordance with the requirements of ASTM D 790.

1.2.2.2.2. The CONTRACTOR shall provide certified test results of the short term properties of the cured liner material from the actual installed liner at a minimum of one **sample per inversion (minimum of one per each 2,000 linear feet of installed liner).**

1.2.2.3. Corrosion resistance tests: Corrosion resistance requirements shall be as stated in ASTM F 1216, Section X2, Chemical Resistance Tests. **CONTRACTOR shall submit valid resistance tests per ASTM D543.**

1.3. EXECUTION

1.3.1. General

1.3.1.1. The CONTRACTOR shall protect the manholes to withstand forces generated by equipment, water, or air pressures used while installing the tube.

1.3.1.2. Where "LINE THROUGH MANHOLE" is indicated on the drawings, the CIPP shall be inverted through the manhole and the circular shape of the host pipe shall be maintained. The CIPP is not to be trimmed, cut, or otherwise disturbed after installation.

1.3.1.3. The CONTRACTOR shall have sufficient backup **TV Inspection (TVI)** cameras, bypass pumps, **property service connections (PSC)** cutters, intruding property service connection cutters, and appurtenances on site such that the progress of work will not be significantly impeded by equipment failures.

1.3.2. Preparation

1.3.2.1. All site work shall be performed or supervised by personnel experienced in the installation of the liner as specified herein.

1.3.2.2. The uncured resin in the original containers and the unimpregnated fiber-felt tube shall be impregnated by vacuum or other means prior to installation. The materials and wet-out procedure shall be subject to inspection by MSD. **On-site and "over-the-hole"**

wet-outs shall be acceptable. Transportation of the impregnated tube to the jobsite shall be done in accordance with the manufacturer's recommendations.

1.3.2.3. The impregnated liner bag shall be transported to and stored at the site such that it will not be damaged, exposed to heat and/or direct sunlight, or result in any public safety hazard. All materials shall be subject to inspection and review by MSD prior to installation.

1.3.3. Bypass Pumping

1.3.3.1. Bypass pumping shall consist of furnishing, installing, and maintaining all power, primary and standby pumps, appurtenances and bypass piping required to maintain existing and peak hourly flows and services. The CONTRACTOR shall submit a plan for bypass pumping in accordance with MSD standards and special provisions, if any. The CONTRACTOR shall be aware that homes in the area may have sump pumps connected to the sanitary sewer. The bypass pumping plan shall include an emergency response plan to be followed in the event of a failure of the bypass pumping system or sump pump activity during the rehabilitation process.

1.3.3.2. Bypass pumping shall be done in such a manner as to not damage private or public property, or create a nuisance or public menace. The pumped sewage shall be in an enclosed hose or pipe that is adequately protected from traffic, and shall be redirected into the sanitary sewer system. Dumping or free flow of sewage on private property, gutters, streets, sidewalks, or into storm sewers is prohibited. The CONTRACTOR shall be liable for all cleanup, damages, and resultant fines in the event of a spill. After the work is completed, flow shall return to the rehabilitated sewer.

1.3.3.3. The CONTRACTOR shall take all necessary precautions to ensure that no private properties are subjected to sewage backup or spill.

1.3.3.4. The CONTRACTOR shall be liable for all damages and related expenses resulting from CONTRACTOR's work.

1.3.4. Cleaning and Inspection

1.3.4.1. The CONTRACTOR shall be responsible for cleaning, inspecting, confirming the inside diameter, and determining the condition of each manhole to manhole segment of the existing sanitary sewer to be lined. The CONTRACTOR shall note that the existing sewer may have heavy solids, such as drain rock and collapsed sections of pipe, protruding property service connections or root intrusion. The cleaning operation shall be performed in a manner not to further damage the existing pipe. Hydroflushing or balling shall not be permitted.

1.3.4.2. The CONTRACTOR shall perform an internal television inspection after the sewer cleaning operations, point repairs, and root removal is completed and prior to reintroduction of flow to the sewer (**without live flows**). The television inspection shall be completed in the same direction each time and shall be done with logs using **NAASCO PACP** codes and color **digital video** format. A pivot head camera shall be used for all TVI. TVI shall be performed in the presence of the MSD INSPECTOR and

the INSPECTOR shall decide whether the sewer is properly prepared for liner installation. A copy of the TVI **documentation** and logs shall be provided to the MSD INSPECTOR at the earliest possible date.

1.3.4.3. The CONTRACTOR shall capture, remove, and dispose of all waste materials related to cleaning that could potentially cause a sewer backup, damage existing facilities such as pump stations or cause sedimentation in the downstream sewer system **in a proper manner in accordance with applicable regulations.**

1.3.5. Point Repairs

1.3.5.1. It shall be the responsibility of the CONTRACTOR to clear the lines of obstructions such as solids, offset joints, **intruding laterals**, or collapsed pipe that will prevent the insertion of the liner. If inspection reveals an obstruction that cannot be removed by conventional sewer cleaning equipment, the CONTRACTOR shall notify MSD and provide TVI and/or other documentation of the obstruction. MSD will then determine the method of correction which may include excavation to uncover and remove or repair the obstruction. The CONTRACTOR shall be responsible for viewing MSD's TVI **documentation** prior to bidding, if available. The CONTRACTOR is responsible for bidding point repairs found on any line segment scheduled for relining in the unit cost for lining when **video documentation** and or logs are available for review. In all other cases, the CONTRACTOR will be reimbursed on a time and material bases in accordance with the contract documents or by other means agreeable to both the CONTRACTOR and MSD.

1.3.5.2. A point repair is defined as replacing the existing pipe with a new pipe having the same internal diameter. Suitable pipe materials consist of PVC, RCP, and DIP. The CONTRACTOR shall provide a flexible rubber Calder-type coupling with type 316 stainless steel bands at each end of the replaced section in order to connect the new pipe with the existing line. The replaced section of pipe shall provide a smooth transition between the existing and the new pipe. The excavation, pipe installation, backfill, and surface restoration shall be performed in accordance with MSD standards and applicable transportation regulatory agency requirements. The adjustment of protruding property service connections using remote equipment shall be incidental to the lining process unless directed otherwise by MSD or its representative. **CIPP installation shall be continuous through all new point repairs.**

1.3.5.3. The CONTRACTOR shall update the point repair section of the final **as-built drawings** to reflect the actual work performed and shall submit the completed **as-built drawings** to MSD or its representative prior to acceptance testing.

1.3.6. Liner Installation

1.3.6.1. The liner shall be installed through an existing manhole or other access point approved by the ENGINEER by means of the installation process and application of hydrostatic head, compressed air, or other means sufficient to fully expand and extend the liner to the next designated manhole or termination point.

1.3.6.2. The liner shall be installed at a rate not to exceed 32 feet per minute.

1.3.6.3. The inversion head shall be such that, allowing for minor impact, at no time will the hoop tension in the felt liner exceed 500 psi or the hoop stress in the polyurethane membrane exceed 8,000 psi.

1.3.6.4. The liner shall be handled in a manner preventing the contact of resins and epoxy with ground surface, pavement, sidewalks, or driveways. All spillage of resins and epoxies shall be promptly addressed in accordance with manufacturer recommendations and MSDS requirements. Removal of spilled materials shall be the responsibility of the CONTRACTOR and shall be performed at no additional cost to MSD.

1.3.7. Curing

1.3.7.1. After liner placement is completed, a suitable heat source and distribution equipment shall be provided to distribute or circulate hot water **or steam** throughout the pipe. The equipment shall be capable of delivering hot water **or steam** throughout the section by means of a pre-strung hose which has been perforated per the manufacturer's recommendations or other approved means to uniformly raise the temperature to that required to effectively cure the resin. The temperature shall be determined by the manufacturer and based on the resin/catalyst system employed.

1.3.7.2. The heat source piping shall be fitted with continuous monitoring thermocouples to gauge the temperature of the incoming and outgoing water. Temperatures during the cure period shall meet the requirements of the resin manufacturer as measured at the heat source inflow and outflow return lines. The CONTRACTOR shall provide standby equipment to maintain supply of the heat source. An additional continuous monitoring thermocouple shall be placed between the impregnated felt tube and the pipe invert at the remote manhole and at a point midway between the upstream and downstream manholes to determine the temperature during cure. The temperature during the cure shall not be more than 190° F or less than 140°F at the boundary between the pipe and the liner.

1.3.7.3. Initial cure shall be deemed to be completed when inspection of the exposed portions of the liner appear hard and sound and the remote sensor indicates that an exothermic reaction has occurred. The cure period shall be of the duration recommended by the resin manufacturer during which time the recirculation of the water and cycling of the heat exchanger to maintain the temperature takes place continuously.

1.3.7.4. Temperature shall be maintained during the curing period as recommended by the resin manufacturer and shall follow the heating schedule supplied by the manufacturer and reviewed by the ENGINEER.

1.3.8. Cool-Down

1.3.8.1. The hardened liner shall be cooled to a temperature below 100°F before relieving the head in the inverted pipe. Cool-down may be accomplished by introduction of cool water into the inverted tube to replace the water being drained from a small hole made in the downstream end. Care shall be taken in the release of the static head so that a vacuum will not develop that could damage the newly installed liner.

1.3.8.2. After the tube is cured, a cool-down period shall be used prior to opening the downstream plug and returning normal flow back into the system. **Cool-down shall be in accordance with the manufacturers recommendations.**

1.3.8.3. **End seal connections shall always be installed and shall be a seal** consisting of a resin mixture compatible with the liner/resin system shall be applied in accordance with the manufacturer specifications and approved by the ENGINEER.

1.3.9. Service Connections

1.3.9.1. All existing property service connections shall be reconnected by the CONTRACTOR after the pipe has been lined. The reconnection of services shall be done without excavation using a television camera-directed cutting device unless otherwise specified by MSD. All reconnected services shall be free of burrs and frayed edges and any restriction preventing free wastewater flow and/or lateral lining. Location of services shall be made by inspection of the pre-inversion TVI **documentation** or other proven methods.

1.3.9.2. Any connection not satisfactory to MSD shall be repaired with additional CIPP or by installation of service connection lining at no additional cost to MSD.

1.3.9.3. The CONTRACTOR is responsible for removing all coupons resulting from PSC reinstatement.

1.3.10. Testing

1.3.10.1. The CONTRACTOR shall provide MSD with **color digital video** showing the completed work **without live flows** including all lateral connections. The video must be provided to MSD prior to testing of property service connections.

1.3.10.2. Acceptance testing shall be performed using Focused Electrode Leak Location (FELL 41) system of pipe inspection and shall be performed by an independent third party contractor experienced in the use of the FELL 41 system.

1.3.11. FELL 41 Test Method

1.3.11.1. The FELL 41 test shall be conducted on a sample of 12.5% +/- 2.5% of the total linear footage of mainline pipe rehabilitated using CIPP. Testing shall be performed only on nonconductive host pipe. It shall be the responsibility of the CIPP contractor to accurately identify the host pipe material based on preinstallation TVI.

1.3.11.2. The pipe to be tested shall be selected by MSD or its representative after review of post-installation TVI.

1.3.11.3. The FELL 41 testing shall be conducted in accordance with the **manufacturers** recommended practices. The FELL 41 contractor shall be responsible for any damages to public or private property resulting from FELL 41 testing activities.

1.3.11.4. The following limits shall be used to determine the significance of detected anomalies.

Pipe Diameter	Green zone	Yellow zone	Red Zone
8-inch	0 – 4.5 amps	>4.5 – 5.5 amps	>5.5 amps
10-inch	0 – 3.0 amps	>3.0 – 4.0 amps	>4.0 amps
12-inch	0 – 2.5 amps	>2.5 – 3.5 amps	>3.5 amps

- Green zone anomalies are considered unconditionally acceptable
- Yellow zone anomalies are considered acceptable however; these sections will be targeted for future inspection during the warranty period.
- Red zone anomalies are considered unacceptable. The CIPP contractor at no additional cost to MSD must address these defects.

1.3.11.5. Pipes with multiple Red zone anomalies shall be failed. For each failed pipe, an additional pipe section shall be added to the test group and tested at no additional cost to MSD.

1.3.11.6. CIPP installations shall be considered acceptable when no Red zone anomalies are detected.

1.3.11.7. All pipes with Red zone anomalies shall be retested after CONTRACTOR has addressed the defect at no additional cost to MSD.

1.3.11.8. The FELL 41 contractor shall provide analyzed test results to the both the CONTRACTOR and MSD or its representative within 2 business days of testing each section.

1.3.12. Warranty

The CONTRACTOR shall provide MSD a warranty to be in force and effect for a period of five (5) years from the date of acceptance by MSD. The warranty shall require the CONTRACTOR to repair or replace the liner should leakage, separation, de-lamination, collapse, or other failure as determined by the ENGINEER result from faulty materials or installation.

SECTION 2

MSD STANDARD I/I SPECIFICATION

LATERAL REHABILITATION

2.1. GENERAL

2.1.1. Description of Work

This section covers the work necessary to restore existing service connections by the installation of cured-in-place pipe (CIPP). CIPP is formed by inverting a resin impregnated flexible tube into the service lateral using hydrostatic head and curing with circulating hot water, **air/steam inversions**, or other approved means to produce a hard, impermeable pipe. The CONTRACTOR shall provide all materials, labor, equipment, and services necessary for bypass pumping of sewage flows, cleaning and television inspection of sewer to be lined, installation of liner, and final television inspection and testing of lined laterals. This specification represents **minimum** standards and the CONTRACTOR shall abide by any manufacturer specifications that exceed these specifications.

2.1.2. Reference Standards

ASTM F 1216	Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube.
ASTM D 638	Standard Test Method for Tensile Properties of Plastics.
ASTM D 648	Standard Test Methods for Deflection Temperature of Plastics Under Flexural Load.
ASTM D 790	Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
ASTM D 2583	Standard Test Methods for Determination of Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor.
ASTM D 2990	Standard Test Methods for Tensile, Compressive, and Flexural Creep and Creep-Rupture of Plastics.
NAASCO	Recommended Specifications for Sewer Collection System Infrastructure Analysis and Rehabilitation Manual.
NAASCO	Pipeline Assessment and Certification Program (PACP).
Federal EPA	Sewer System Infrastructure Analysis and Rehabilitation Manual.

2.1.3. Acceptable CIPP Reconstruction Systems/Processes

The only acceptable Cured-In-Place lateral reconstruction system/processes for pipe installation work are Insituform, In-Liner, National Liner, Performance Liner and T-Liner systems or approved equal.

2.1.4. CONTRACTOR Submittals

2.1.4.1. All CONTRACTOR Project Submittals shall be submitted to MSD within 14 days of Notice to Proceed issuance. All submittals must be approved by MSD prior to the start of construction. Required submittals are as follows:

- A. Bypass Pumping Plan – shop drawing showing bypass pumping locations with sufficient detail to assure that the work can be accomplished without sewage spill.
- B. Sample **Customer** Notification.
- C. Traffic Control Plan including shop drawings and signage in accordance with MUTCD guidelines.
- D. Construction Calculations for liner size and thickness, including assumptions used in calculations **per latest version of ASTM F1216. Include a schedule of pipe segments.**
- E. Manufacturer Specifications for resins and liner material. **Provide third party laboratory test data showing short/long term physical properties of CIPP system being used.**
- F. Construction Plan including the following submittals; insertion locations **and schedule, inversion plan complete with lengths of inversions**, material storage location, installation procedures, sampling procedures, project schedule, erosion control plan, **location of wet-out facility, safety plan, emergency spill plan, chemical safety plan, MSDS sheets**, and cleanup plan.

2.1.4.2. All submittals shall identify the specification section(s) they address.

2.1.5. CONTRACTOR Availability

2.1.5.1. The PRIME CONTRACTOR shall be on site during preparation of the lateral for lining and from the beginning of the inversion until the PSC has been lined.

2.1.5.2. The CONTRACTOR shall have a local or 1-800 cellular phone or pager active at all times.

2.1.6. Quality Assurance

2.1.6.1. The CONTRACTOR shall clean the host pipe, remove all roots, and make any necessary point repairs prior to conducting pre-inversion TVI for submittal to MSD.

2.1.6.2. The finished liner shall be continuous over the entire length of the inversion run from cleanout or other termination point approved by the ENGINEER to the mainline and shall be free of visual defects such as wrinkles, bulges, tears, foreign inclusions, cracks, crazing, dry spots, pinholes, or de-lamination.

2.1.6.3. Prior to each liner inversion and after completion of all service connection inversions, the service connection shall be televised in color **digital video** using **NAASCO PCAP** codes and suitable logs taken. All TVI taping shall be performed from the cleanout or terminal point to the mainline. The logs and the **digital video documentation** shall be provided to MSD.

2.1.6.4. If lateral lining is accomplished via blind shot, the TVI inspection shall be accomplished to the degree possible during execution mainline TVI.

2.1.7. Public Notification

2.1.7.1. 72 hours prior to disruption of service, the CONTRACTOR shall notify property owners, public, residents, and all others who may be affected using a notification form approved by MSD.

2.1.7.2. The CONTRACTOR shall disrupt customer service for no longer than 12 hours. If service will be disrupted for more than 12 hours, the CONTRACTOR must notify affected customers of the delay and, if necessary, provide bypass pumping at no additional cost to MSD.

2.1.8. Project Site Documentation

2.1.8.1. The CONTRACTOR shall take two pre-rehab **digital** photos per lateral rehab and/or cleanout valve installation clearly identifying the date, time, street address, and project name.

2.1.8.2. The CONTRACTOR shall take two post-rehab **digital** photos per lateral rehab and/or cleanout valve installation clearly identifying the date, time, street address, and project name.

2.1.8.3. The CONTRACTOR shall place the **digital** photos **on a CD/DVD along with an index** including the following information; corresponding photo number, contract number, street address, CONTRACTOR name, and date.

2.1.8.4. **Project documentation** shall be submitted to the MSD INSPECTOR at the earliest possible date.

2.1.8.5. Upon completion of installation, the CONTRACTOR shall update the final **as-built drawings** to reflect the actual work performed and shall submit the completed **as-built drawings** to MSD or its representative prior to acceptance testing.

2.1.8.6. Photo requirements are waived for blind shot installations unless excavation is required.

2.2. MATERIALS

2.2.1. Cured-in-Place Pipe – shall be in compliance with ASTM F1216. The liner tube being installed shall be sized correctly, allowing for stretch, to tightly fit the inside of the existing pipe.

2.2.1.1. The liner tube shall consist of one or more layers of flexible needle felt or an equivalent woven and/or non-woven material capable of carrying resin, withstanding installation pressures and curing temperatures, and that is compatible with the resin system used. The resin used shall be compatible with the rehabilitation process, shall be able to cure in the presence or absence of water and the initiation temperature for cure shall be as recommended by the resin manufacturer.

2.2.1.2. The finished lining shall provide a smooth bore interior, be continuous in length, be of uniform thickness, and fit tight against the inside of the existing pipe wall. The liner shall be fabricated from materials that when cured, will be chemically resistant to withstand internal exposure to sewage gases containing quantities of hydrogen sulfide, carbon monoxide, methane, petroleum hydrocarbons, saturation with moisture and dilute sulfuric acid.

2.2.1.3. **The CONTRACTOR shall verify both the lengths and diameters for the tobes before they are manufactured.** The minimum length shall be that deemed necessary by the CONTRACTOR to effectively span the distance from the mainline to the clean out unless otherwise specified. The CONTRACTOR shall verify the PSC lengths and diameters in the field before impregnation.

2.2.1.4. Prior to inversion the liner shall be free of all visible tears, holes, cuts, foreign materials, and other defects.

2.2.1.5. The physical properties of the cured liner **shall be in accordance with ASTM D790 and ASTM D638 and** shall have minimum values as follows:

	<u>Polyester Resin</u>	
	<u>Short Term</u>	<u>Long Term</u>
Flexural Strength (psi)	4,500	
Flexural Modulus (psi)	250,000	125,000
Tensile Strength at Yield (psi)	3,000	

2.2.1.6. The liner shall conform to the following:

<u>Parameter</u>	<u>Pipe</u>
Minimum Thickness of bonded polyurethane membrane and inner liner	0.25 mm + 5% percent
Resin Content (w/i ±5%)	85% resin, 15 % felt by volume
Nominal Outside Diameter	Internal diameter of host pipe
Thickness	Per ASTM F 1216
Hardness	(Barcol) 22 ASTM D 2583
Heat Distortion Temperature	70° C ASTM D 648

(CONTRACTOR shall field verify internal diameter of existing sewer prior to sizing liner.)

2.2.1.7. The liner thickness is based on the resin's mechanical properties. The liner shall have a wall thickness as set forth in ASTM F 1216 and be structurally sound and without joints. The CONTRACTOR shall calculate the wall thickness for a fully deteriorated pipe. The CONTRACTOR shall submit detailed calculations of the proposed liner thickness for approval by the ENGINEER. Calculations shall consider external hydrostatic pressure, static and earthload pressures and internal, surcharged pressures. The liner shall be sized in accordance with the design parameters shown below:

Design Life:	50 years
Ovality:	An ovality of 6 percent shall be used.
Soil Modulus:	A soil modulus of 1,000 psi shall be used.
Soil Weight	125 lbs/cf
Enhancement Factor:	An enhancement factor of 7 shall be used.
Excess Resin:	The 5 percent excess resin requirement shall not be used in determining liner thickness. The supplier, however, shall provide excess resin to meet the project specific requirements.

2.2.1.8. The resin used shall not contain fillers except those required for viscosity control. A thixotropic agent in an amount up to 5 percent by mass may be added for viscosity control.

2.2.2. Materials Testing

2.2.2.1. General. All materials testing shall be performed at the CONTRACTOR's expense and by an independent third party laboratory approved by MSD. The sample shall be taken in accordance with procedures established in the CONTRACTOR's submittals and as approved by MSD. One sample from every 20 laterals rehabilitated shall be taken for analysis. The sample shall be collected in the presence of the MSD INSPECTOR.

2.2.2.2. Physical Properties

2.2.2.2.1. The cured inversion tube material shall be sampled and tested for flexural strength and flexural modulus. Flexural strength and modulus shall be tested in accordance with the requirements of ASTM D 790. Tensile strength shall be tested in accordance with the requirements of ASTM D 638. Long term flexural modulus is defined as 50 years and is determined with ASTM D 2990.

2.2.2.2.2. Chemical Resistance: Corrosion resistance requirements shall be as stated in ASTM F 1216, Section X2, Chemical Resistance Tests. **CONTRACTOR shall submit valid resistance tests per ASTM D543.**

2.2.2.2.3. The sample shall be taken from the actual wet-out liner used in installation unless directed otherwise by MSD or its representative.

2.3. EXECUTION

2.3.1. General

2.3.1.1. The CONTRACTOR shall protect the mainline and/or clean out to withstand forces generated by equipment, water, or air pressures used while installing the tube.

2.3.1.2. The liner shall be installed in accordance with the manufacturer's recommendations.

2.3.1.3. Wet-out of liner shall be conducted in a manner which prevents the contact of resins and epoxy with ground surface, pavement, sidewalks, or driveways. All spillage of resins and epoxies shall be promptly addressed in accordance with manufacturer recommendations and MSDS requirements. Removal of spilled materials shall be the responsibility of the CONTRACTOR and shall be performed at no additional cost to MSD.

2.3.2. Preparation

2.3.2.1. All site work shall be performed or supervised by personnel experienced in the installation of the liner as specified herein

2.3.2.2. The uncured resin in the original containers and the unimpregnated fiber-felt tube shall be impregnated by vacuum or other means prior to installation. The materials and "wet-out" procedure shall be subject to inspection by MSD. A resin and catalyst system that is compatible with the requirements of the method shall be used. **On-site and "over-the-hole" wet-outs shall be acceptable. Transportation shall be in accordance with manufacturers recommendations.**

2.3.2.3. The impregnated liner bag shall be transported to and stored at the site in such a manner that it will not be damaged, exposed, to heat and/or direct sunlight or result in any public safety hazard. All materials shall be subject to inspection and review by MSD prior to installation

2.3.2.4. The mainline pipe opening shall be prepared to accept a lateral CIPP and the mainline rehabilitated pipe shall be maximized to obtain the best possible water-tight seal.

2.3.3. Bypass Pumping

2.3.3.1. Bypass pumping shall consist of furnishing, installing, and maintaining all power, primary and standby pumps, appurtenances and bypass piping required to maintain existing and peak hourly flows and services. The CONTRACTOR shall submit a plan for bypass pumping in accordance with MSD standards and the Special Provisions. The CONTRACTOR shall be aware that most homes in the area have sump pumps connected to the sanitary sewer. The bypass-pumping plan shall include an emergency response plan to be followed in the event of a failure of the bypass pumping system or sump pump activity during the rehabilitation process.

2.3.3.2. It is required that the service lateral be inactive during the time of installation. This is normally accomplished by turning off the homeowner's services or requesting that the homeowner relinquish using his services during the required period of installation. The CONTRACTOR shall take all necessary precautions to ensure that no private properties are subjected to sewage backup or spill.

2.3.3.3. Bypass pumping shall be done in such a manner as to not damage private or public property, or create a nuisance or public menace. The pumped sewage shall be in an enclosed hose or pipe that is adequately protected from traffic, and shall be redirected into the sanitary sewer system. Dumping or free flow of sewage on private property, gutters, streets, sidewalks, or into storm sewers is prohibited. The CONTRACTOR shall be liable for all cleanup, damages, and resultant fines in the event of a spill. After the work is completed, flow shall be returned to the rehabilitated lateral and the sewer.

2.3.3.4. The CONTRACTOR shall be liable for all damages resulting from CONTRACTOR's work.

2.3.3.5. The CONTRACTOR shall disrupt customer sewer service for no longer than 12 hours. If the service will be disrupted more than 12 hours, the CONTRACTOR must notify the homeowner and provide on site bypass pumping as required at no additional cost to MSD until the service is restored.

2.3.4. Cleaning and Inspection

2.3.4.1. The CONTRACTOR shall be responsible for cleaning, inspecting, confirming the inside diameter, and determining the condition of each existing service lateral to be lined. The CONTRACTOR shall note that the existing lateral may have heavy solids, such as drain rock and collapsed sections of pipe, or root intrusion. The cleaning operation shall be performed in a manner not to further damage the existing pipe. Hydroflushing or balling shall not be permitted.

2.3.4.2. The CONTRACTOR shall perform an internal television inspection after the sewer cleaning operations, point repairs, and root removal is completed and prior to reintroduction of flow to the sewer. The television inspection shall be completed in the same direction each time and shall be done with logs using approved **NAASCO PACP** codes and color **digital video** format. TVI shall be performed in the presence of the MSD INSPECTOR and the INSPECTOR shall decide whether the lateral is properly prepared for liner installation. The original TVI **documentation** and logs shall be provided to the MSD INSPECTOR at the earliest possible date.

2.3.4.3. The CONTRACTOR shall capture, remove, and dispose of all waste materials related to cleaning that could potentially cause a sewer backup, damage existing facilities such as pump stations or cause sedimentation in the downstream sewer system **in accordance with applicable local regulations**.

2.3.5. Point Repairs

2.3.5.1. It shall be the responsibility of the CONTRACTOR to clear the line of obstructions such as solids, offset joints, or collapsed pipe that will prevent the

installation of the liner. If inspection reveals an obstruction that cannot be removed by conventional sewer cleaning equipment, the CONTRACTOR shall notify MSD and provide TVI and/or other documentation of the obstruction. MSD will determine the preferred method of correction which may include excavation to uncover and remove or repair the obstruction.

2.3.5.2. The CONTRACTOR shall be responsible for viewing MSD's TVI **documentation** and/or logs prior to bidding, if available. The CONTRACTOR is responsible for bidding point repairs found on any lateral scheduled for relining in the unit cost for lining when **video documentation** and/or logs are available for review. In the event that lateral TVI is unavailable, the CONTRACTOR shall be responsible only for those defects identifiable with mainline TVI. In all other cases, the CONTRACTOR will be reimbursed in accordance with the contract documents or by other means agreeable to both the CONTRACTOR and MSD.

2.3.5.3. A point repair is defined as replacing the existing pipe having the same internal diameter. Suitable pipe materials consist of PVC, RCP, and DIP. The CONTRACTOR shall provide a flexible rubber Calder-type coupling with type 316 stainless steel bands at each end of the replaced section in order to connect it with the existing sanitary sewer. The replaced section of pipe shall provide a smooth transition from the existing pipe to the new pipe. The excavation, pipe installation, and backfill shall be performed in accordance with MSD specifications at the CONTRACTORS expense. **Install CIPP through the point repair unless the entire laterals replaced, then no need for CIPP.**

2.3.5.4. The CONTRACTOR shall update the point repair section of the **As-built drawings** to reflect the actual work performed and shall submit the completed **As-built drawings** to the MSD or its representative prior to acceptance testing.

2.3.6. Liner Installation

2.3.6.1. The liner shall be installed from the mainline, clean out, or other access approved by the ENGINEER, by means of the installation process and the application of hydrostatic head, compressed air, or other means sufficient to fully expand and extend the liner to the termination point.

2.3.6.2. The liner shall be installed at a rate not to exceed 32 feet per minute.

2.3.6.3. The inversion head shall be such that, allowing for minor impact, at no time the hoop tension in the felt liner shall exceed 500 psi or the hoop stress in the polyurethane membrane exceed 8000 psi.

2.3.7. Curing

2.3.7.1. After liner placement is completed, a suitable heat source and distribution equipment shall be provided to distribute or circulate hot water **or steam** throughout the pipe. The equipment shall be capable of delivering hot water **or steam** throughout the section by means of a pre-strung hose which has been perforated per the manufacturer's recommendations or other methods acceptable to the ENGINEER to uniformly raise the

temperature above the temperature required to effect cure of the resin. This temperature shall be determined by the manufacturer based upon the resin/catalyst system employed.

2.3.7.2. The heat source piping shall be fitted with continuous monitoring thermocouples to gauge the temperature of the incoming and outgoing water. Temperatures during the cure period shall meet the requirements of the resin manufacturer as measured at the heat source inflow and outflow return lines. The CONTRACTOR shall provide standby equipment to maintain supply of the heat source. An additional continuous monitoring thermocouple shall be placed between the impregnated felt tube and the pipe invert at the termination point. The temperature during the cure shall be not be more than 190° F or less than 140° F at the boundary between the pipe wall and the liner.

2.3.7.3. Initial cure shall be deemed to be completed when inspection of the exposed portions of the liner appears hard and sound and the remote temperature sensor indicates that an exothermic reaction has occurred. The cure period shall be of duration recommended by the resin manufacturer during which time the circulation of the water and cycling of the heat exchanger to maintain the temperature continuously takes place.

2.3.7.4. Temperature shall be maintained during the curing period as recommended by the resin manufacturer and shall follow the heating schedule supplied by the manufacturer and reviewed by the ENGINEER.

2.3.8. Cool-Down

2.3.8.1. The hardened liner shall be cooled to a temperature below 100° F before relieving the head in the inversion pipe. Cool-down may be accomplished by the introduction of cool water into the inversion tube to replace water being drained from a small hole made in the downstream end. Care shall be taken in the release of the static head so that a vacuum will not develop that could damage the newly installed liner.

2.3.8.2. After the tube is cured, a cool-down period shall be used prior to opening the downstream plug and returning normal flow back into the system. **Cool-down shall be in accordance with the manufacturers recommendations.**

2.3.8.3. **End seal connections shall always be installed and shall be a seal** consisting of a resin mixture compatible with the liner/resin system shall be applied in accordance with manufacturer specifications and approved by the ENGINEER.

2.3.9. Service Connections

2.3.9.1. After installation of the liner and testing is completed, the CONTRACTOR shall turn on the homeowner's services and notify the homeowner that services may be used again.

2.3.9.2. The service lateral and mainline interface shall be free of burrs and frayed edges and any restriction preventing free wastewater flow. Any connection not satisfactory to MSD shall be repaired with additional CIPP or by reinstallation of service connection lining at no additional cost to MSD.

2.3.9.3. The connection between the mainline and the lateral shall be water tight.

2.3.10. Cleanouts

2.3.10.1. Unless noted otherwise in the special provisions section or the proposal section, cleanouts shall be installed in conjunction with lateral rehabilitation. Installation of cleanouts shall be in accordance with the MSD standard drawing: Two Way Cleanout, Standard Drawing No. Sc-02-00.

2.3.10.2. The CONTRACTOR shall compact the soil to 95% or use other approved means to prevent settling of the cleanout.

2.3.10.3. The cleanout shall be installed at the edge of the property line, unless otherwise directed by the MSD INSPECTOR. See the special provisions section for additional requirements.

2.3.10.4. If required, the CONTRACTOR shall install the cleanout in the existing sidewalk. The sidewalk shall be reconstructed in accordance with the City of Louisville Standard drawing T-111. The texture, grade, and expansion joint shall match that of the existing sidewalk.

2.3.10.5. There shall be no open cuts left open overnight and sites shall be re-sodded/restored within 1 week, unless directed otherwise by the MSD INSPECTOR.

2.3.10.6. MSD reserves the right to assign site restoration work to an alternate CONTRACTOR if the work is not completed within one week or to MSD's satisfaction. In which case, the additional costs will be deducted from the Prime CONTRACTOR's final pay.

2.3.10.7. The CONTRACTOR shall ensure that no dirt or debris enters the sewer system as a result of cleanout installation.

2.3.11. Testing

2.3.11.1. When mainline CIPP is performed in conjunction with lateral rehabilitation, FELL 41 testing of the mainline shall be considered sufficient for property service connection testing. If a lateral is rehabilitated but the mainline is not rehabilitated, the property service connection shall be low-pressure air tested in accordance with these specifications.

2.3.11.2. The CONTRACTOR shall provide MSD with **digital** video showing the completed work including the restored conditions after work is complete on all laterals with available cleanout access.

2.3.11.3. After rehabilitation of the lateral, the CONTRACTOR shall perform a low pressure air test to determine if the lateral is water tight. This test shall be conducted on at least 5% but not more than 10 % of the laterals rehabilitated when mainline rehabilitation is not performed. The test shall be conducted on the lateral from the sewer main to the cleanout if available such that the entire lateral liner and connection to the main line is

tested. In the event that a cleanout is unavailable for access to the lateral, only the connection to the mainline shall be subject to a low pressure air test. If the failure rate is 5% or less, the work shall be considered acceptable. If the failure rate is greater than 5%, an additional test area of the same size as the original area shall be selected and tested. This process shall continue until a 95% or greater pass rate for combined test areas is achieved. Testing beyond the original test area shall be conducted at no additional cost to MSD. The CONTRACTOR shall furnish all equipment to conduct the test. The test shall be as follows:

2.3.11.3.1. Pressurize the test section to 4.0 psi and hold above 3.5 psi for not less than 2 minutes. Add air if necessary to keep the pressure above 3.5 psi. At the end of this 2 minute stabilization period, note the pressure (must be 3.5 psi minimum) and begin the timed period. If the pressure drops 0.5 psi in less than the time given in the table below, the section of pipe shall have failed the test.

<u>Sewer Size (inches)</u>	<u>Minimum Test Time (minutes)</u>
4	2
6	3
8	4

2.3.11.3.2. When the prevailing ground water is above the sewer being tested, test pressure shall be increased by 0.43 psi for each foot that the water table is above the invert of the sewer.

2.3.11.3.3. If the time for the pressure to drop 0.5 psi is 125% or less of the time given in the table, the line shall immediately be repressurized to 3.5 psi and the test repeated.

2.3.11.3.4. Laterals shall be plugged at the cleanout and the main line shall be plugged on either side of the lateral connection. The entire lateral and main line interface shall be subject to the low pressure air test.

2.3.11.3.5. The pressure gage used shall be supplied by the CONTRACTOR and have minimum divisions of 0.10 psi.

2.3.11.4. If a section of sewer is failed, pressure testing may be used to locate the defect. Once the defect is located, it shall be repaired as recommended by the manufacturer. Additional work due to liner failure shall be conducted at no expense to MSD.

2.3.12. Warranty

The CONTRACTOR shall provide MSD a warranty to be in force and effect for a period of five (5) years from the date of acceptance by MSD. The warranty shall require the CONTRACTOR to repair or replace the liner should leakage, separation, de-lamination, collapse, or other failure as determined by the ENGINEER result from faulty materials or installation.

SECTION 3

MSD STANDARD I/I SPECIFICATION

CHEMICAL GROUTING

3.1. GENERAL

3.1.1. Description of Work

This section covers the work necessary to restore existing sanitary sewers **and manholes** by remotely sealing leaking joints, small holes, and radial cracks in structurally sound sewer pipes **and manholes** using chemical sealing (grouting) materials. The CONTRACTOR shall provide all materials, labor, equipment, and services necessary for bypass pumping of sewage flows, cleaning and television inspection of sewer to be grouted, application of grout, and final television inspection. This specification represents **minimum** standards and the CONTRACTOR shall abide by any manufacturer specifications that exceed these specifications.

3.1.2. CONTRACTOR Submittals

3.1.2.1. All CONTRACTOR Project Submittals shall be submitted to MSD within 14 days of Notice to Proceed issuance. All submittals must be approved by MSD prior to the start of construction. Required submittals are as follows:

- A. Bypass Pumping Plan – shop drawing showing bypass pumping locations with sufficient detail to assure that the work can be accomplished without sewage spill.
- B. Sample Customer Notification
- C. Traffic Control Plan including shop drawings and signage in accordance with MUTCD guidelines
- D. Manufacturer Specifications for all grouts and component materials
- E. Construction Plan including the following submittals; insertion locations, material storage location, installation procedures, sampling procedures, project schedule, erosion control plan, removal of residual sealing materials from the sewer line and cleanup plan.

3.1.2.2. All submittals shall identify the specification section(s) they address.

3.1.3. Quality Assurance

3.1.3.1. The sealed joints shall be reasonably free of residual sealing materials that extend into the pipe, reduce the pipe diameter, or restrict the flow.

3.1.3.2. After completion of all grouting, the sewer shall be televised in color **digital video** format using **NAASCO PACP** codes and suitable logs taken. The logs and the original **digital video documentation** shall be provided to the MSD INSPECTOR.

3.1.4. Public Notification

3.1.4.1. 72 hours prior to disruption of service the CONTRACTOR shall notify property owners, public, residents, and all who may be affected using a notification form approved by MSD.

3.1.4.2. The CONTRACTOR shall disrupt customer sewer service for no longer than 12 hours. If service will be disrupted for more than 12 hours, the CONTRACTOR must notify affected customers and MSD of the delay

3.2. MATERIALS

3.2.1. General

3.2.1.1. While being injected, the grouting must be able to react in the presence of water. The cured material must also be able to withstand submergence in water without degradation.

3.2.1.2. The resultant sealant formation must prevent the passage of water (infiltration) through the sewer pipe joint or repair location.

3.2.1.3. The cured sealant material must be flexible. In place, the sealant formation should be able to withstand the freeze thaw and wet/dry cycles without adversely affecting the seal. The sealant formation must not be biodegradable.

3.2.1.4. The cured sealant should be chemically stable and resistant to withstand internal exposure to sewage gases containing quantities of hydrogen sulfide, carbon monoxide, methane, petroleum hydrocarbons, and dilute sulfuric acid.

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

3.2.1.6. Mixing of component materials must be compatible with field operations and not require precise measurement of the ingredients by field personnel.

3.2.1.7. Cleanup must be done without excessive use of flammable or hazardous chemicals. 3.2.1.8. Residual sealing materials must be easily removable from the sewer line to prevent reduction or blockage of sewage flow.

3.2.2. Acrylamide Base Gel Sealing Materials

3.2.2.1. A minimum of 10% acrylamide base material by weight in the total sealant mix. A higher concentration may be used to increase strength or offset dilution during injection.

- 3.2.2.2. The ability to tolerate some dilution and react in moving water during injection.
- 3.2.2.3. A viscosity of approximately 2 centipoise which can be increased with additives.
- 3.2.2.4. A controlled reaction time from 10 seconds to 1 hour.
- 3.2.2.5. A reaction producing a homogeneous, chemically stable, non-biodegradable, firm, and flexible gel.
- 3.2.2.6. The ability to increase mix viscosity, density, and gel strength through the use of additives.

3.2.3. Acrylic Base Gel Chemical Sealing Material

- 3.2.3.1. A minimum of 10% acrylamide base material by weight in the total sealant mix. A higher concentration may be used to increase strength or offset dilution during injection.
- 3.2.3.2. The ability to tolerate some dilution and react in moving water during injection.
- 3.2.3.3. A viscosity of approximately 2 centipoise which can be increased with additives.
- 3.2.3.4. A controlled reaction time from 5 seconds to 6 hours.
- 3.2.3.5. A reaction producing a homogeneous, chemically stable, non-biodegradable, firm, and flexible gel.
- 3.2.3.6. The ability to increase mix viscosity, density, and gel strength through the use of additives.

3.2.4. Urethane Base Gel Chemical Sealing Material

- 3.2.4.1. 1 part urethane prepolymer thoroughly mixed with between 5 and 10 parts of water byweight. The recommended urethane prepolymer concentration is 11% by weight.
- 3.2.4.2. A liquid prepolymer having a solids content of 77% to 83%, specific gravity of 1.04 (8.65 pounds per gallon), and a flash point of 20°F.
- 3.2.4.3. A liquid prepolymer having a viscosity of 600 to 1200 centipoise at 70°F.
- 3.2.4.4. The water used to react the prepolymer should have a pH of 5 to 9.
- 3.2.4.5. A cure time of 80 seconds at 40°F, 55 seconds at 60°F, and 30 seconds at 80°F when 1 part prepolymer is reacted with 8 parts of water containing a sufficient amount of gel control additive.

3.2.4.6. A relatively rapid viscosity increase of the prepolymer/water mix. Viscosity increases from about 10 to 60 centipoise in the first minute for 1 to 8 prepolymer/water ratio at 50°F.

3.2.4.7. A reaction which produces a chemically stable and non-biodegradable, tough, flexible gel.

3.2.4.8. The ability to increase mix viscosity, density, gel strength, and resistance to shrinkage by the use of additives to the water.

3.2.5. Urethane Base Foam Chemical Sealing Material

3.2.5.1. Approximately 1 part urethane prepolymer mixed thoroughly with 1 part water by weight.

3.2.5.2. A liquid prepolymer having a solids content of 82% to 88%, specific gravity of 1.1 (9.15 pounds per gallon), and a flash point of 20°F.

3.2.5.3. A liquid prepolymer having a viscosity of 300 to 500 centipoise at 72°F.

3.2.5.4. A cure time of 5.5 minutes at 40°F, 8.2 minutes at 70°F, and 2.6 minutes at 100°F when the prepolymer is reacted with water containing 0.4% accelerator.

3.2.5.5. A cure time of 15 minutes at 40°F, 8.2 minutes at 70°F, and 4.6 minutes at 100°F when the prepolymer is reacted with water only.

3.2.5.6. During injection; foaming, expansion, and viscosity increase occurs.

3.2.5.7. Physical properties of the cured foam of approximately 14 pounds per cubic foot density, 80-90 psi tensile strength, and 700% to 800% elongation when a mixture of 50% prepolymer and 50% water undergoes a confined expansion to five times its initial liquid volume.

3.3. EXECUTION

3.3.1. General

3.3.1.1. The grouting material shall be prepared and applied in accordance with manufacturer recommendations.

3.3.1.2. The CONTRACTOR shall protect the manholes to withstand forces generated by equipment, water, or air pressures used while installing the grout.

3.3.2. Preparation

3.3.2.1. All site work shall be performed or supervised by personnel experienced in the application of grouting as specified herein.

3.3.2.2. The materials and application procedure shall be subject to inspection by MSD.

3.3.2.3. The packaging of component materials must be compatible with field storage and handling requirements such that it will not be damaged or result in any public safety hazard. All materials shall be subject to inspection and review by MSD prior to installation.

3.3.3. Bypass Pumping

3.3.3.1. Bypass pumping shall consist of furnishing, installing, and maintaining all power, primary and standby pumps, appurtenances and bypass piping required to maintain existing and peak hourly flows and services. The CONTRACTOR shall submit a plan for bypass pumping in accordance with MSD standards and applicable Special Provisions. The CONTRACTOR shall be aware that most homes in the area have sump pumps connected to the sanitary sewer. The bypass-pumping plan shall include an emergency response plan to be followed in the event of a failure of the bypass pumping system or sump pump activity during the rehabilitation process.

3.3.3.2. Bypass pumping shall be done in such a manner as to not damage private or public property, or create a nuisance or public menace. The pumped sewage shall be in an enclosed hose or pipe that is adequately protected from traffic, and shall be redirected into the sanitary sewer system. Dumping or free flow of sewage on private property, gutters, streets, sidewalks, or into storm sewers is prohibited. The CONTRACTOR shall be liable for all cleanup, damages, and resultant fines in the event of a spill. After the work is completed, flow shall be returned to the rehabilitated sewer.

3.3.3.3. The CONTRACTOR shall take all necessary precautions to ensure that no private properties are subjected to sewage backup or spill.

3.3.3.4. The CONTRACTOR shall be liable for all damages resulting from CONTRACTOR's work.

3.3.4. Cleaning and Inspection

3.3.4.1. The CONTRACTOR shall be responsible for cleaning, inspecting, confirming the inside diameter, and determining the condition of each manhole-to-manhole segment of the existing sewer to be grouted. The CONTRACTOR shall note that the existing sewer may have heavy solids, such as drain rock and collapsed sections of pipe, or root intrusion. The mixing of root treatment materials with chemical sealing materials will not be allowed. All debris shall be removed from the downstream manhole. And disposed of off-site in a manner approved by MSD at the CONTRACTOR's expense. The cleaning operation shall be performed in a manner not to further damage the existing pipe. Hydroflushing or balling shall not be permitted.

3.3.4.2. The CONTRACTOR shall perform an internal television inspection after the sewer cleaning operation, point repairs and grouting is completed, and before flow is reintroduced into the sewer. The television inspection shall be completed in the same direction each time and shall be done with logs using approved **NAASCO PACP** codes and a color **digital video** format. The logs and television inspection **digital** video

documentation from all televising operations shall be approved by MSD prior to grouting. A pivot head camera shall be used for all television inspection.

3.3.4.3. The CONTRACTOR shall capture, remove, and dispose of all waste materials related to cleaning that could potentially cause a sewer backup, damage existing facilities such as pump stations or cause sedimentation in the downstream sewer system.

3.3.5. Equipment

3.3.5.1. The basic equipment shall consist of a **TVI** system, necessary chemical sealant containers, pumps, regulators, valves, hoses, etc., and joint sealing packers for the various sizes of sewer pipes.

3.3.5.2. 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 shall be constructed in a manner to allow a restricted amount of sewage to flow.

3.3.6. Joint Sealing Procedure

3.3.6.1. Joint sealing shall be accomplished by forcing chemical sealing materials into or through faulty joints by a system of pumps, hoses, and sealing packers.

3.3.6.2. The packer shall be positioned over the faulty joint by means of a measuring device and the **TVI** camera in the line.

3.3.6.3. The packer ends 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 pipe line.

3.3.6.4. Into this isolated area, sealant materials shall be pumped through the hose system at controlled pressures which are in excess of groundwater pressures. The pumping unit, metering equipment, and the packer device shall be designed so that proportions and quantities of materials can be regulated in accordance with the type and size of the leak being sealed.

3.3.7. Joint Sealing Verification

3.3.7.1. 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 tested as specified below.

3.3.7.2. Should the void pressure meter not read zero, the CONTRACTOR shall clean his equipment of residual grout material or make the necessary repairs/adjustments to produce accurate void pressure readings.

3.3.7.3. Joints that fail to meet the specified test criteria shall be resealed and retested until the test criteria can be met.

3.3.8. Sewer Pipe Joint Testing

3.3.8.1. Joint testing pressure shall be 3 psi higher than the groundwater pressure, if any, outside the pipe. Groundwater pressure may be determined by positioning the testing device on a visibly infiltrating joint and measuring the resulting void pressure with the void pressure monitoring equipment (usually a packer). There is generally a practical limit of 10 psi for the test pressure.

3.3.8.2. In the absence of groundwater pressure data, the test pressure shall be equal to ½ psi per vertical foot of pipe depth or 3 psi, whichever is greater.

3.3.9. Residual Sealing Materials

3.3.9.1. 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.

3.3.9.2. If excessive residual sealing materials accumulate in the line and/or if directed by an MSD representative, the manhole section shall be cleaned to remove the residual materials.

3.3.9.3. Complete records shall be kept of joint sealing performed in each manhole section. The records shall identify the manhole section in which the sealing was done, the location of each joint sealed and the joint sealing verification results.

3.3.10. Warranty

3.3.10.1. The CONTRACTOR shall provide MSD a warranty to be in force and effect for a period of five (5) years from the date of acceptance by MSD against leakage of grout repairs. The warranty shall require the CONTRACTOR to repair the defective joint at no cost to MSD.

SECTION 4

MSD STANDARD I/I SPECIFICATION

MANHOLE REHABILITATION – MECHANICALLY LOCKING CHIMNEY SEALS

4.1. GENERAL

4.1.1. Description of Work

This section covers the work necessary to restore an existing manhole's frame and chimney interface using internal/**external** mechanically locking chimney seals. This specification represents **minimum** standards and the CONTRACTOR shall abide by any manufacturer specifications that exceed these specifications.

4.1.2. CONTRACTOR Submittals

4.1.2.1. All CONTRACTOR Project Submittals shall be submitted to MSD within 14 days of Notice to Proceed issuance. All submittals must be approved by MSD prior to the start of construction. Required submittals are as follows:

- A. The CONTRACTOR shall provide manufacturer specifications, details of physical properties, and handling/storage requirements for all materials used to **perform the work included in this specification.**
- B. The CONTRACTOR shall submit a list of compatible products for use in manhole preparation for chimney seal installation.
- C. The CONTRACTOR shall submit manufacturer requirements for properly sizing chimney seals **and field measurements as required in 4.3.2.1.**
- D. The CONTRACTOR shall submit manufacturer certification for chimney seal installation.
- E. Warranty information as required under section 4.3.7.**

4.1.2.2. All submittals shall identify the section(s) of the specifications they address.

4.2. MATERIALS

4.2.1. The mechanically locking chimney seal shall consist of a molded or extruded high-grade butyl rubber sleeve affixed to the inside of the manhole by a stainless steel expansion band. Sealing surfaces shall be capable of accommodate slight irregularities of the manhole surfaces. The sleeve shall be pleated with a minimum unexpanded height of 8-, 10-, or 13- inches. The chimney seals shall be used as directed on the contract drawings and meet or exceed the physical characteristics listed in section 4.2.2 and ASTM C 923.

4.2.2. Physical Properties

Tensile Strength	1,500 psi
Elongation at Break	350% minimum
Vertical Expansion	capable of not less than 2 inches when installed
Hardness (durometer)	48±5
Accelerated Oven Aging	Max 15% decrease of tensile and 20% decrease of elongation
Chemical Resistance	No weight loss in 1N of sulfuric or Hydrochloric acid
Compressive Set	18% max decrease
Water Absorption	max 10% increase by weight
Low Temperature Brittle Point	No fracture at -40°C
Tear Resistance	200 lb. f/in
Splice Strength	180° bend with no visible separation

4.2.3. Rubber seals, lid gaskets, and pickhole plugs shall be manufactured by Cretex Specialty Products or approved equal.

4.2.4. Expansion bands and appurtenances shall conform to manufacturer recommended standards for the chimney seal system.

4.2.5 All materials, such as grouts, used in manhole preparation for chimney seal installation shall conform with the recommendations of the chimney seal manufacturer.

4.3. EXECUTION

4.3.1. General

4.3.1.1. All manhole rehabilitation work shall be performed personnel **certified by the manufacturer** in the installation of mechanically locking chimney seals. The CONTRACTOR shall be responsible for all damage to riser rings or other components of the structure that result from use of hydraulic installation tools.

4.3.1.2. Only those manholes identified in the contract special provisions and/or on the contract drawings shall be rehabilitated, unless otherwise noted.

4.3.1.3. No multiple chimney seal extensions will be allowed unless directed otherwise by the MSD INSPECTOR.

4.3.1.4. Lid gaskets and pick hole plugs shall be sized and installed in accordance with manufacturer recommendations.

4.3.2. Project Documentation

4.3.2.1. The CONTRACTOR shall provide at least three acceptable digital photos of the manhole to be rehabilitated by manhole number and photo number (example XXXXXX-X), as follows:

4.3.2.1.1. Pre-rehab location photo showing identifying landmarks and manhole number.

4.3.2.1.2. Pre-rehab overhead photo looking directly into the manhole.

4.3.2.1.3. Post-rehab overhead photo (oriented identically to pre-rehab photo) of installed chimney seal and extension, if applicable.

4.3.2.1.4. Post-rehab external photo detailing the completed site work if site restoration is required.

4.3.2.2. All photos shall have the north side of the manhole clearly and consistently identified.

4.3.2.3. The CONTRACTOR shall use the Manhole Rehabilitation Record Sheet presented in the Special Provisions to document manhole condition and recommendations for rehabilitation. All record sheets shall be placed in a three-ring binder(s) and delivered to the ENGINEER at the earliest possible date.

4.3.2.4. The CONTRACTOR shall use the **As-built drawings** provided by MSD to record the results of the pre-installation manhole inspection. The pre-inspection results shall be mark “draft” and presented to the ENGINEER for review and acceptance prior to beginning rehab work. Upon completion of chimney seal installation, the CONTRACTOR shall update the **As-built drawings** to reflect the actual work performed and shall submit the completed **As-built drawings** to the MSD or its representative prior to Manhole acceptance testing.

4.3.3. Pre-Installation Inspection

4.3.3.1. The CONTRACTOR shall field measure the manhole in accordance with the manufacturer’s requirements. Copies of these measurements shall be submitted to the MSD INSPECTOR as soon as is practical.

4.3.3.2. The CONTRACTOR shall inspect and recommend manholes for alignment if the frame is offset by 2 inches or greater relative to the riser ring(s), top slab or cone. Manholes meeting this criterion shall be, at the direction of the MSD INSPECTOR, re-centered by the CONTRACTOR at the unit costs set forth in the Proposal.

4.3.3.3. The CONTRACTOR shall inspect and recommend manholes to be raised to grade if an 8 foot straight edge centered on the manhole lid shows at least a 1 ½ inch drop between the manhole lid and the straight edge at two points separated by 90° and the potential for pooling of water exists. If a manhole is a candidate for raising to grade, the MSD INSPECTOR will make the final determination. The MSD INSPECTOR may require the manhole be tested for ponding potential by plugging the pick holes and pouring 5 gallons of water onto the manhole lid. If the water pools to a level greater than

1 inch on the manhole lid, the manhole shall be raised. The MSD INSPECTOR must be present during this test, verify the test results, and make the final determination.

4.3.3.4. Manholes that are located in areas subject to regular flooding or significant overland flows, such as those in drainage ditches, channels, and curbs shall be identified as candidates for watertight manhole covers. The MSD INSPECTOR will make the final decision regarding watertight cover installation.

4.3.3.5. Manhole castings with loose lids and/or oversized pick holes that are located in areas subject to overland flows, minor ponding, and/or occasional minor flooding shall be recommended for lid gaskets, and/or pick hole plugs.

4.3.3.6. Manholes with solid grade adjustment ring(s) or 2-piece casting(s) shall be rehabilitated using an approved chemical chimney seal product. If the grade adjustment ring is not solid (compression type), it shall be removed and the manhole raised to grade. See special provisions item related to 2 piece castings and irregular manhole rehabilitation.

4.3.3.7. If additional manholes are found by the CONTRACTOR between those indicated on the Contract Drawings, the CONTRACTOR shall notify MSD using the LOJIC Errata form located in the special provisions section of the contract. At the direction of MSD the additional manholes shall be rehabilitated by the CONTRACTOR at the appropriate unit costs set forth in the Proposal. If the CONTRACTOR does not find manholes indicated on the Contract Drawings in the field, the CONTRACTOR shall notify MSD in writing concerning the missing manhole. The CONTRACTOR will not be compensated for manholes indicated on the Contract Drawings but not found and inspected in the field by the CONTRACTOR. From time to time, MSD will assist the CONTRACTOR in finding sets of missing manholes.

4.3.4. Manhole Preparation

4.3.4.1. Cast iron steps that interfere with the installation of a chimney seal and/or extension shall be removed prior to preparing the manhole for chimney seal installation. These steps are not to be re-installed.

4.3.4.2. All cracked, missing or otherwise deteriorated riser rings shall be, at the direction of MSD, replaced or restored by the CONTRACTOR at the appropriate unit costs set forth in the Proposal and in accordance with MSD standards.

4.3.4.3. The surfaces against which the seal and/or extension is to be compressed shall be circular, clean, reasonably smooth, and free of any loose material and excessive voids. If the masonry surface is rough or irregular, and would not provide an effective seal, it shall be smoothed with an approved non-shrink mortar. If necessary, A bead of butyl rubber caulk, conforming to AASHTO M-198, Type B, may be applied to the lower sealing surface of the chimney seal to fill any minor irregularities in the mortar surface. Any flaws in the manhole frame such as cracks, pits, or protrusions shall be repaired by either filling with mortar or grinding smooth. Mortar shall be sufficiently cured to withstand pressures applied during installation.

4.3.4.4. The CONTRACTOR shall capture, remove, and dispose of all waste materials related to cleaning that could potentially cause a sewer backup, damage existing facilities such as pump stations or cause sedimentation in the downstream sewer system.

4.3.4.5. After the chimney seal has been positioned in the manhole, the stainless steel expansion bands shall be installed in the top and bottom band recesses and individually tightened to provide a water tight seal. The installed seal and/or extension shall not be excessively expanded or contracted.

4.3.4.6. If a wedge insert is needed to adapt the chimney seal to a sloping surface, it shall be installed in the wedge insert band recess and expanded as required to provide a watertight seal.

4.3.4.7. Detailed installation instructions shall be in accordance with the manufacturer's instructions.

4.3.5. Quality Assurance

4.3.5.1. The CONTRACTOR shall ensure that lower sealing points are watertight by introducing water between the manhole chimney and the seal/extension prior to top band installation.

4.3.5.2. All installations may be subject to visual inspection by MSD or its representative prior to project closeout and final payment. The CONTRACTOR shall correct any deficiencies identified during the visual inspection at no additional cost to MSD.

4.3.5.3. The CONTRACTOR shall be responsible for all damage to riser rings or other components of the structure that result from use of hydraulic installation tools.

4.3.6. Testing

4.3.6.1. The CONTRACTOR shall provide all materials and personnel required to conduct an acceptance test of installed chimney seals and/or extensions.

4.3.6.2. The test shall be conducted in the presence of a MSD INSPECTOR or representative on manholes selected by MSD or its representative.

4.3.6.3. Manholes failing the acceptance test must have the chimney seal and/or extension reinstalled and retested.

4.3.6.4. MSD or its representative shall select at least 5% but not more than 10% of the manholes in the rehabilitation area for testing. These manholes shall be representative of the majority of the manholes rehabilitated. If the failure rate is less than 5% the work shall be deemed acceptable. If the failure rate is greater than 5%, an additional test area of the same size as the original test area will be selected for testing. If the failure rate of the combined area is less than 5% the work shall be deemed acceptable. The testing process shall continue until a failure rate less than 5% is achieved. Testing beyond the initial test area shall be conducted at no additional cost to MSD.

4.3.6.5. Static Head Test

4.3.6.5.1. A 1 foot tall section of PVC pipe with external diameter matching the internal diameter of the manhole frame shall be temporarily sealed to the frame. A drawing of the test setup is included in the Special Provisions section.

4.3.6.5.2. Sandbags or an approved alternative shall be used to form a 6 inch tall ring around the PVC pipe allowing a 6 inch annular space between the PVC pipe and the ring.

4.3.6.5.3. The space between the sandbags and the PVC pipe shall be filled with water to a height of 6 inches and the water level maintained for 10 minutes.

4.3.6.5.4. During the test, the chimney seal and extension, if used, shall be failed if any visible, continuous stream of water leaking from the sealed area is observed.

4.3.6.6. Gravity Test

4.3.6.6.1. At the direction of MSD or its representative and as an alternative to the static head test, approximately 1 quart of water may be introduced directly behind the seal and extension, if used, to perform a gravity test of the installation.

4.3.6.6.2. During the test, the chimney seal and extension, if used, shall be failed if any visible, continuous stream of water leaking from the sealed area is observed.

4.3.7. Saturation Test

4.3.7.1. When manholes to be tested are in unpaved areas and sufficient head cannot be developed for a static head test, saturation of the ground is considered an acceptable alternative. The saturation test shall be conducted by applying water to the ground surface for 10 minutes and observing the seal for leakage.

4.3.7.2. During the test, the chimney seal and extension, if used, shall be failed if any visible, continuous stream of water leaking from the sealed area is observed.

4.3.8. Warranty

The CONTRACTOR shall provide MSD a warranty to be in force and effect for a period of five (5) years from the date of acceptance by MSD. The warranty shall require the CONTRACTOR to repair or replace the chimney seal if leakage or other failure as determined by the ENGINEER results from faulty material and/or installation.

SECTION 5

MSD STANDARD I/I SPECIFICATION

MANHOLE REHABILITATION – **NON-MECHANICAL** CHIMNEY SEAL

5.1. GENERAL

5.1.1. Description of Work

This section covers the work necessary to restore an existing manhole's frame and chimney interface using **non-mechanical** chimney seals. **The use of non-mechanical chimney seals shall be restricted to non-paved area.** This specification represents **minimum** standards and the CONTRACTOR shall abide by any manufacturer specifications that exceed these specifications.

5.1.2. CONTRACTOR Submittals

5.1.2.1. All Project Submittals shall be submitted to MSD within 14 days of Notice to Proceed issuance. All submittals must be approved by MSD prior to the start of construction. Required submittals are as follows:

- A. The CONTRACTOR shall provide manufacturer specifications, **manufacturer recommendation for installation and quality assurance**, details of physical properties, and handling/storage requirements for all materials used in manhole preparation for **non-mechanical** chimney seal installation and the chimney seal product.
- B. The CONTRACTOR shall submit a list of compatible products for use in **performance of the work included in this specification.**
- C. The CONTRACTOR shall submit proof of manufacturer certification for chimney seal installation.
- D. All submittals shall identify the section(s) of the specifications they address.
- E. Warranty information as required under section 5.3.6.**

5.2. MATERIALS

5.2.1. Chemical Chimney Seals shall be Flex Seal Utility Sealant as manufactured by Sealing Systems Inc., or approved equal.

5.2.2. Physical Properties

Tensile Strength	1,100 psi
Flexural Strength	6,000 psi
Elongation at Break	200% minimum
Hardness (durometer)	50

Tear Resistance

150 lb. f/in

In addition, exposure of the product to the sewer environment shall not result in loss of weight, elasticity, or cause notable deterioration of the product.

5.2.3. All materials, such as grouts, used in manhole preparation for chimney seal installation shall conform with the recommendations of the chimney seal manufacturer and with MSD specifications for manhole construction unless directed otherwise by MSD or its representative.

5.3. EXECUTION

5.3.1. General

5.3.1.1. All manhole rehabilitation work shall be performed or supervised by personnel certified by the manufacturer for the handling and installation of the chimney seal product.

5.3.1.2. Only those manholes identified in the contract special provisions, Record Listing, and/or on the contract drawings and not suitable for installation of the Internal Mechanically Locking Chimney Seal shall be rehabilitated, unless otherwise noted.

5.3.1.3 Project Documentation

5.3.1.3.1. The CONTRACTOR shall provide at least three acceptable digital photos of the manhole to be rehabilitated by manhole number and photo number (example XXXXXX-X), as follows:

- A. Pre-rehab location photo showing identifying landmarks and manhole number.
- B. Pre-rehab overhead photo looking directly into the manhole.
- C. Post-rehab overhead photo (oriented identically to pre-rehab photo) of installed chimney seal and extension, if applicable.
- D. Post-rehab external photo detailing the completed site work if site restoration is required.

5.3.1.3.2. All photos shall have the north side of the manhole clearly and consistently identified.

5.3.1.3.3. The CONTRACTOR shall use the Manhole Rehabilitation Record Sheet presented in the Special Provisions to document manhole condition for rehabilitation. All record sheets shall be placed in a three-ring binder(s) and delivered to the ENGINEER at the earliest possible date.

5.3.1.3.4. The CONTRACTOR shall use the as-built record drawings provided by MSD to record the results of the pre-installation manhole inspection. The pre-inspection results shall be mark "draft" and presented to the ENGINEER for review and acceptance prior to

beginning rehab work. Upon completion of chimney seal installation, the CONTRACTOR shall update the as-built drawings to reflect the actual work performed and shall submit the completed as-built drawings to MSD or its representative prior to manhole acceptance testing.

5.3.2. Pre-Installation Inspection

5.3.2.1. A pre-installation manhole inspection shall be conducted in accordance with Section 4 of the MSD Standard I/I Specifications. The Chemical Chimney Seal shall be recommended for use only when an internal mechanically locking chimney seal cannot be properly installed.

5.3.2.2. Chemical Chimney Seals shall be used when a manhole can not be adequately prepared or if excessive material will be necessary to prepare the manhole for installation of a mechanically locking Seal or if a solid grade adjustment ring (2-piece casting) has been previously installed in the manhole. The CONTRACTOR shall not rehabilitate any manhole using a Chemical Chimney seal without prior approval by MSD or its representative.

5.3.2.3. Chemical chimney seals may not be used in manholes with HDPE riser rings unless approved in writing by the product manufacturer and MSD or its representative.

5.3.3. Manhole Preparation

5.3.3.1. Cast iron steps that interfere with the installation of a chemical chimney seal shall be removed prior to preparing the manhole for chimney seal installation. These steps are not to be re-installed. If steps are to be left in place, they shall be properly prepared for chimney seal application and the applied seal must overlap the edges of the step by at least 3 inches

5.3.3.2. Manhole preparation shall be in accordance with the manufacturer's instructions and Specification unless directed otherwise by MSD or its representative.

5.3.3.3. The CONTRACTOR shall capture, remove, and dispose of all waste materials related to cleaning that could potentially cause a sewer backup, damage existing facilities such as pump stations or cause sedimentation in the downstream sewer system.

5.3.4. Installation

5.3.4.1. Chemical Chimney Seal installation shall be in accordance with manufacturer recommendations including those for coating thickness unless directed otherwise by MSD or its representative.

5.3.4.2. Coverage area for the chimney shall be from 3-inches above the casting/chimney interface to 3-inches below the last chimney interface or 18-inches whichever is smaller. Coverage area for the grade adjustment ring shall be from the lid stop to 3-inches below the grade adjustment ring/casting interface. Refer to the Contract Special Provisions Section for coverage area detail drawing.

5.3.4.3. The ambient air temperature during installation and for a minimum of 10 hours after installation shall be at least 45°F for the installation of Flex Seal Utility Sealant and 50°F for the installation of AquataFlex. Installation between November 15 and March 31 is strictly prohibited unless temperature are adequate to support installation and the CONTRACTOR obtains permission from MSD or its representative.

5.3.4.4. Voids shall be repaired prior to installation using quick set cement as recommended by the manufacturer. Repairs must be fully cured prior to chemical seal application. In no instance shall the chemical chimney seal product be used to bridge voids greater than ½ -inch wide.

5.3.4.5. The CONTRACTOR shall not install the product if significant rainfall is expected before the product is sufficiently cured to withstand water contact per the manufacturer recommendations.

5.3.5. Testing

5.3.5.1. The CONTRACTOR shall provide all materials and personnel required to conduct an acceptance test of installed chimney seals and/or extensions. The test shall be a static head test and shall be performed as follows:

5.3.5.1.1. A 1-foot tall section of PVC pipe with external diameter matching the internal diameter of the manhole frame shall be temporarily sealed to the frame. A drawing of the test setup is included in the Special Provisions section.

5.3.5.1.2. Sandbags or an approved alternative shall be used to form a 6 inch tall ring around the PVC pipe allowing a 6 inch annular space between the PVC pipe and the ring.

5.3.5.1.3. The space between the sandbags and the PVC pipe shall be filled with water to a height of 6 inch and the water level maintained for 10 minutes.

5.3.5.1.4. During the test, Seals shall be failed if any visible, continuous streams of water leaking from the sealed area are observed.

5.3.5.1.5. The test shall be conducted in the presence of an MSD INSPECTOR or representative on manholes selected by MSD or its representative.

5.3.5.1.6. Manholes failing the acceptance test must have the chimney seal repaired or reinstalled and retested.

5.3.5.2. MSD or its representative shall select at least 5% but not more than 10% of the manholes in the rehabilitation area for testing. These manholes shall be representative of the majority of the manholes rehabilitated. If the failure rate is less than 5% the work shall be deemed acceptable. If the failure rate is greater than 5%, an additional test area of the same size as the original test area will be selected for testing. If the failure rate of the combined area is less than 5% the work shall be deemed acceptable. The testing process shall continue until a failure rate less than 5% is achieved. Testing beyond the initial test area shall be conducted at no additional cost to MSD.

5.3.5.3. The Static Head Test shall be performed no sooner than 30 days after completing the installation of Flex Seal and no sooner than 2 days after completing the installation of AquataFlex. For alternative products, the testing will be conducted after the product has fully cured per manufacturer recommendations.

5.3.5.4. When manholes to be tested are in unpaved areas and sufficient head cannot be developed for a static head test, saturation of the ground is considered an acceptable alternative. The saturation test shall be conducted by applying water to the ground surface for 10 minutes and observing the seal for leakage.

5.3.6. Warranty

The CONTRACTOR shall provide MSD a warranty to be in force and effect for a period of five (5) years from the date of acceptance by MSD. The warranty shall require the CONTRACTOR to repair or replace the chimney seal if leakage or other failure as determined by the ENGINEER results from faulty material and/or installation.

SECTION 6

MSD STANDARD I/I SPECIFICATION

MANHOLE REHABILITATION – EPOXY COATING

6.1. GENERAL

6.1.1. Description of Work

This specification covers the work required for protecting and/or rehabilitating concrete structures by spray-application of a monolithic high-build epoxy coating to eliminate infiltration, provide corrosion protection, repair voids and enhance structural integrity. These specifications represent **minimum** requirements and the CONTRACTOR shall abide by any manufacturer specification that exceeds these specifications.

6.1.2. Reference Standards

ASTM D638	Tensile Properties of Plastics.
ASTM D790	Flexural Properties of Unreinforced and Reinforced Plastics.
ASTM D695	Compressive Properties of Rigid Plastics.
ASTM D4542	Pull-off Strength of Coatings Using a Portable Adhesion Tester.
ASTM D2584	Volatile Matter Content.
ASTM D2240	Durometer Hardness, Type D.
ASTM D543	Resistance of Plastics to Chemical Reagents.
ASTM C109	Compressive Strength Hydraulic Cement Mortars.
ASTM C348	Flexural Strength Hydraulic Cement Mortars.
ASTM C396	Compressive Strength of Cement Mortars.
ACI 506.2-77	Specifications for Materials, Proportioning, and Application of Shotcrete.
ASTM C579	Compressive Strength of Chemically Setting Silicate and Silica Chemical Resistant Mortars
ASTM D4414	Standard Practice for Measurement of Wet Film Thickness of organic Coatings by Notched Gages

6.1.3. CONTRACTOR Submittals

6.1.3.1. All CONTRACTOR Project Submittals shall be submitted to MSD within 14 days of Notice to Proceed issuance. All submittals must be approved by MSD prior to the start of construction. Required submittals are as follows:

- A. Bypass Pumping Plan – shop drawing showing bypass pumping locations with sufficient detail to assure that the work can be accomplished without sewage spill, **if required.**
- B. Sample **Customer** Notification.
- C. Equipment Failure Plan.
- D. Third Party Testing Credentials.
- E. Traffic Control Plan including shop drawings and signage in accordance with MUTCD Guidelines.
- F. Construction Calculations for **coating** thickness, including assumptions used in calculations. **Thicknesses should be in accordance with manufacturer’s recommendations.**
- G. Manufacturer Specifications for repair, manhole preparation and **coating** materials
- H. Material Safety Data Sheets (MSDS) for each product used.
- I. Design details for any additional ancillary systems and equipment to be used for site and surface preparation, application and testing.
- J. Construction Plan including the following submittals; material storage location, manufacturer installation specifications and procedures, sampling procedures, project schedule, and cleanup plan.
- K. Proof of applicator’s qualification

6.1.3.2. All submittals shall identify the specification section(s) they address.

6.1.4. Applicator Qualifications

6.1.4.1. Repair mortar applicators shall be trained to properly apply the cementitious mortar according to manufacturer’s recommendations.

6.1.4.2. Manufacturer certification that Applicator has been trained and approved in the handling, mixing and application of the products to be used.

6.1.4.3. Certification by the protective coating manufacturer that the equipment to be used for applying the products has been approved and Applicator personnel have been trained and certified for proper use of the equipment.

6.1.4.4. Proof of any necessary federal, state or local permits or licenses necessary for the project.

6.1.5. CONTRACTOR Availability

6.1.5.1. The PRIME CONTRACTOR shall be on site during all phases of installation.

6.1.5.2. The CONTRACTOR shall have a local or 1-800 cellular phone or pager active at all times.

6.1.6. Project Documentation

6.1.6.1. The CONTRACTOR shall provide at least three acceptable **digital photos of the manhole to be rehabilitated by manhole number and photo number (example XXXXXX-X), as follows:**

- A. Pre-rehab location photo showing identifying landmarks and manhole number.
- B. Pre-rehab photo(s) showing manhole defect(s).
- C. Post-rehab photo(s) of rehabilitated manhole (oriented identically to shot 2).
- D. Post-rehab external photo detailing the completed site work if site restoration is required. All external photos shall have the north side of the manhole clearly and consistently identified and all interior photos shall have the orientation identified as a clock reading with north being 12 o'clock.

6.1.6.2. The CONTRACTOR shall use the Manhole Rehabilitation Record Sheet presented in the special provisions section. All photos shall be placed in a three-ring binder(s) and delivered to the ENGINEER at the earliest possible date. An index shall be included with the each binder. The index shall include: corresponding photo number, contract number, street address where appropriate, record drawing number, CONTRACTOR name, location by station, and date.

6.1.6.3. Upon completion of installation, the CONTRACTOR shall update the **As-built drawings** to reflect the actual work performed and shall submit the completed **As-built drawings** to the MSD or its representative prior to acceptance testing.

6.1.7. Quality Assurance

6.1.7.1. The finished **coating** system shall be continuous over the entire surface and shall be free from visual defects such as wrinkles, bulges, tears, crazing, foreign inclusions, dry spots, delamination, and pinholes.

6.1.7.2. Applicator shall initiate and enforce quality control procedures consistent with applicable ASTM, NACE and SSPC standards and the protective coating manufacturer's recommendations.

6.1.8. Safety

6.1.8.1. It is the responsibility of the CONTRACTOR to conform to all applicable local, state and federal regulations including those of OSHA, RCRA and the EPA and any other applicable authorities.

6.1.8.2. The CONTRACTOR shall contact MSD's " Base 1" or other central dispatch point as designated by MSD at the Pre-construction meeting prior to and after leaving each manhole.

6.1.9. Public Notification

6.1.9.1. 72 hours prior to disruption of service, the CONTRACTOR shall notify property owners, public, residents, and all others who may be affected using a notification form approved by MSD.

6.1.9.2. The CONTRACTOR shall disrupt customer service for no longer than 12 hours. If service will be disrupted for more than 12 hours, the CONTRACTOR must notify affected customers of the delay and, if necessary, provide bypass pumping at no additional cost to MSD.

6.2. MATERIALS

6.2.1. Storage and Handling

6.2.1.1. Materials are to be kept dry, protected from weather and stored under cover.

6.2.1.2. Protective coating materials are to be stored between 50°F and 90°F. Do not store near flame, heat or strong oxidants.

6.2.1.3. Protective coating materials are to be handled according to their material safety data sheets.

6.2.2. Existing Products

6.2.2.1. Standard Portland cement or new concrete (not quick setting high strength cement) must be well cured prior to application of the protective coating. Generally, 28 days is adequate cure time for standard Portland. If earlier application is desired, compressive or tensile strength of the concrete can be tested to determine if acceptable cure has occurred.

6.2.2.2. Cementitious patching and repair materials should not be used unless their manufacturer provides information as to its suitability for topcoating with an epoxy coating. Project specific submittals should be provided including application, cure time

and surface preparation procedures which permit optimum bond strength with the epoxy coating.

6.2.3. Repair

All repair materials shall be compatible with the specified epoxy coating and shall be applied in accordance with the manufacturer's recommendations. The following product types may be used for repairs; 100% solids epoxy grout, factory blended, rapid setting, high early strength, fiber reinforced, non-shrink repair mortar, or shotcrete composed of Portland Cement, aggregate and water so proportioned as to produce a concrete suitable for pneumatic application.

6.2.4. Protective Coating

The epoxy coating system shall be a 100% solids, solventless two-component epoxy resin system, thixotropic in nature, and filled with select fillers to minimize permeability and provide sag resistance acceptable to these specifications. **The minimum dry-film thickness requirement shall be in accordance with the manufacturer's recommendation.**

6.2.5. Physical Properties

Compressive Strength	4,175 psi
Tensile Strength, psi	2,700 psi
Tensile Elongation, %	3.40%
Flexural Modulus, psi	790,000 psi
Hardness, Type D	87
Bond Strength–Concrete	> Tensile Strength of Concrete

6.2.6. Equipment

6.2.6.1. The CONTRACTOR shall use equipment specifically designed or approved by the protective coating manufacturer for use with the specified epoxy **coating** system.

6.2.6.2. The CONTRACTOR shall use equipment specifically designed or approved by the manufacturer for use with the repair mortar material.

6.3. EXECUTION

6.3.1. Examination

6.3.1.1. Appropriate actions shall be taken to comply with local, state and federal regulatory and other applicable agencies with regard to environment, health and safety.

6.3.1.2. Any active flows shall be dammed, plugged or diverted as required to ensure that the flow is maintained below the surfaces to be coated and shall be conducted in accordance with the bypass pumping plan.

6.3.1.3. Installation of the protective coating shall not commence until the concrete substrate has properly cured and been prepared in accordance with these specifications and those of the epoxy **coating** system's manufacturer.

6.3.1.4. Temperature of the surface to be coated should be maintained between 40°F and 120°F during application. Prior to and during application, care should be taken to avoid exposure of direct sunlight or other intense heat source to the structure being coated. Where varying surface temperatures do exist, care should be taken to apply the coating when the surface temperature is falling versus rising (i.e. late afternoon into evening, as opposed to, morning into afternoon).

6.3.1.5. All existing coatings shall be removed by the CONTRACTOR prior to application of the new protective coating. The CONTRACTOR shall maintain strict adherence to applicable NACE and SSPC recommendations with regard to proper surface preparation and compatibility with existing coatings.

6.3.2. Bypass Pumping (if applicable)

6.3.2.1. Bypass pumping shall consist of furnishing, installing, and maintaining all power, primary and standby pumps, appurtenances and bypass piping required to maintain existing and peak hourly flows and services. The CONTRACTOR shall submit a plan for bypass pumping in accordance with MSD standards and the Special Provisions. The CONTRACTOR shall maintain bypass pumping until the protective coating has cured sufficiently for full flow to be reinstated without damage to the rehabilitated manhole.

6.3.2.2. Bypass pumping shall be done in such a manner as to not damage private or public property, or create a nuisance or public menace. The pumped sewage shall be in an enclosed hose or pipe that is adequately protected from traffic, and shall be redirected into the sanitary sewer system. Dumping or free flow of sewage on private property, gutters, streets, sidewalks, or into storm sewers is prohibited. The CONTRACTOR shall be liable for all cleanup, damages, and resultant fines in the event of a spill.

6.3.3. Surface Preparation

6.3.3.1. Applicator shall inspect all surfaces specified to receive a protective coating prior to surface preparation. Applicator shall notify MSD of any noticeable disparity in the surfaces which may interfere with the proper preparation or application of the repair mortar and protective coating.

6.3.3.2. All concrete that is not sound or has been damaged by chemical exposure shall be removed to a sound concrete surface.

6.3.3.3. All contaminants including: oils, grease, unsound or incompatible existing coatings, waxes, form release, curing compounds, efflorescence, sealers, salts, or other contaminants shall be removed.

6.3.3.4. Surface preparation method(s) should be based upon the conditions of the substrate and the requirements of the epoxy protective coating to be applied.

6.3.3.5. All surfaces shall be repaired in a manner compatible with the epoxy protective coating system and the intended service condition.

6.3.3.6. Surfaces to receive protective coating shall be cleaned and abraded to produce a sound concrete surface with adequate profile and porosity to provide a strong bond between the protective coating and the substrate. Generally, this can be achieved with a high pressure water cleaning using equipment capable of 5,000 psi at 4 gpm. Other methods such as high pressure after jetting (refer to NACE Standard No. 5/SSPC-SP12), abrasive blasting, shotblasting, grinding, or scarifying may also be used. Detergent water cleaning and hot water blasting may be necessary to remove oils, grease or other hydrocarbon residues from the concrete. Whichever method(s) are used, they shall be performed in a manner that is compatible with the epoxy **coating** system and shall provide a uniform, sound clean neutralized surface that is not excessively damaged.

6.3.3.7. A mild chlorine solution may be used to neutralize the surface to diminish microbiological bacteria growth prior to final rinse and coating.

6.3.3.8. Infiltration shall be stopped by using a material which is compatible with the specified repair mortar and is suitable for topcoating with the specified epoxy protective coating.

6.3.3.9. If a specific pH or moisture content of the concrete is required according to manufacturer's recommendations, the prepared surfaces shall be test for pH and/or moisture content of the concrete after cleaning but prior to application of the epoxy coating.

6.3.3.10. All surfaces should be inspected during surface preparation and before the repair mortar is applied.

6.3.3.11. Steps interfering with the installation of the **coating** system shall be removed and not reinstalled.

6.3.3.12. The CONTRACTOR shall capture, remove, and dispose of all waste materials related to cleaning that could potentially cause a sewer backup, damage existing facilities such as pump stations or cause sedimentation in the downstream sewer system.

6.3.4. Application of Repair Materials

6.3.4.1. All repair materials shall be applied according to manufacturer specifications and in a manner compatible with the **coating** system.

6.3.4.2. Areas where structural steel has been exposed or removed shall be repaired in accordance with the manufacturer specification and the **coating** system requirements.

6.3.4.3. The repair materials shall be permitted to cure according to manufacturer recommendations.

6.3.4.4. Application of the repair materials, if not performed by the coating certified applicator, should be inspected by the protective coating manufacturer's representative or

certified applicator to ensure proper finishing for suitability to receive the specified epoxy coating.

6.3.4.5. After abrasive blast and leak repairs have been performed, all surfaces shall be inspected for remaining laitance prior to protective coating application. Any evidence of remaining contamination or laitance shall be removed by additional abrasive blast, shotblast or other approved method. If repair materials are used, refer to these specifications for surface preparation. Areas to be coated must also be prepared in accordance with these specifications after receiving a cementitious repair mortar and prior to application of the epoxy coating.

6.3.4.6. All surfaces should be inspected during and after preparation and before the protective coating is applied.

6.3.5. Application of Protective Coating

6.3.5.1. Application procedures shall conform to the recommendations of the protective coating manufacturer, including material handling, mixing, environmental controls during application, safety, and spray equipment.

6.3.5.2. The spray equipment shall be specifically designed to accurately ratio and apply the specified protective coating materials and shall be regularly maintained and in proper working order.

6.3.5.3. The protective coating material must be spray applied by a Certified Applicator of the protective coating manufacturer.

6.3.5.4. Specified surfaces shall be coated by spray application of a moisture tolerant, solventless, 100% solids, self-priming epoxy protective coating. The coating will be applied to minimum and average wet film thickness that is compatible with MSD's requirements and manufacturer's recommendations.

6.3.5.5. Airless spray application equipment approved by the coating manufacturer shall be used to apply each coat of the protective coating to avoid any potential contamination from compressed air oil which may encourage inter-coat delamination. Air assisted spray application equipment may be acceptable, especially for thinner coats (<10 mils), only if the air source is filtered to completely remove all oil and water.

6.3.5.6. If necessary, subsequent topcoating or additional coats of the protective coating should occur as soon as the basecoat becomes tack free, ideally within 12 hours but no later than 24 hours after the prior coat has been applied at 75°F unless additional prior coat surface preparation is performed. The protective coating manufacturer must be consulted for any additional-coat surface preparation guidelines if necessary.

6.3.5.7. Fiberglass woven-roving fabric may be rolled into the resin or chopped glass spray applied with the resin for added tensile and flexural strength where desired, such as the crown of pipes. Sloped surfaces of the floor may be made non-skid by broadcasting aluminum oxide or silica sand into the surface prior to gelation.

6.3.6. Testing and Inspection

6.3.6.1. During application a wet film thickness gage meeting ASTM D4414 – Standard Practice for Measurement of Wet Film Thickness of Organic Coatings by Notched Gages, shall be used to ensure a monolithic coating of uniform thickness during application.

6.3.6.2. A random sample of 20% of the project manholes shall be subject to vacuum testing in accordance with ASTM C1244. The total quantity of manholes to be tested shall be as specified in the contract special provisions and on the plan set. MSD or its representative shall randomly select the manholes to be tested such that they are spread evenly throughout the project area. The CONTRACTOR shall not be given advance notice of which manholes will be tested to ensure the integrity of the random test process. Manholes shall be capable of holding a vacuum of 5 psi without dropping more than 0.5 psi for the times stated below:

Minimum test times for typical MSD manhole diameters (ASTM C1244-93)

Diameter (in)*		Depth (ft)										
		8	10	12	14	16	18	20	22	24	26	28
		Times (s)										
48	20	25	30	35	40	45	50	55	59	64	69	74
60	26	33	39	46	52	59	65	72	78	85	91	98
72	33	41	49	57	67	73	81	89	97	115	113	121

*Refer to ASTM C1244 –99 for required test times on manholes with other diameters.

Manholes that do not pass the initial vacuum test shall be repaired and retested at no cost to MSD. In addition, for each manhole that fails the initial vacuum test, one additional manhole shall be tested at no additional cost to MSD. This process shall continue until a 100% pass rate is achieved.

6.3.6.3 Spark Testing:

All coated surfaces shall be spark tested for holes. The spark tester used shall provide 100 volts for every one (1) mil thickness applied but may be adjusted as necessary to detect the induced holiday, for example 25,000 volts for a 250 mil thickness coating. If pinholes are found, the CONTRACTOR shall repair the lining as recommended by the manufacturer and retest. All testing and repair work shall be at the CONTRACTOR's expense. The spark testing will be performed as specified herein and any repairs made prior to the final acceptance inspection.

6.3.6.4 Adhesion Tests:

The ENGINEER reserves the right to perform adhesion testing using its own workforce or a qualified testing company. All adhesion testing shall be in accordance with ASTM D3359. Test results showing an adhesion rating of 5A on immersed surfaces and 4A or better on all other surfaces shall be considered acceptable. All costs for removing and reapplying due to adhesion test failures shall be at the CONTRACTOR's expense.

The CONTRACTOR shall perform an adhesion test after complete drying of the coating to demonstrate that the specified field coatings adhere to the substrate. The adhesion test shall be witnessed by the ENGINEER's representative.

6.3.6.5 Dye Testing:

The ENGINEER reserves the right to perform dye testing as needed and introduce water around the outside of the manhole to ensure that the manhole rehabilitation products are properly bonded and providing a seal at all product terminations.

6.3.6.6. A final visual inspection shall be made by the MSD INSPECTOR and manufacturer's representative. Any deficiencies in the finished coating shall be marked and repaired in accordance with manufacturer recommendations by the CONTRACTOR at no additional cost to MSD.

6.3.6.7. The system may be put back into non-severe operational service as soon as the final inspection has taken place. However, for severe corrosion duty such as high concentrations of acids, bases or solvents, 3 to 7 days and/or force cure by heat induction to the coated surfaces may be necessary prior to returning to service. Consult coating manufacturer for further details.

6.3.7. Warranty

Applicator shall warrant all work against defects in materials and workmanship for a period of one (5) year, unless otherwise noted, from the date of final acceptance of the project. Applicator shall, within a reasonable time after receipt of written notice thereof, repair defects in materials or workmanship which may develop during said one (5) year period, and any damage to other work caused by such defects or the repairing of same, at his own expense and without cost to MSD.

SECTION 7

MSD STANDARD I/I SPECIFICATION

MANHOLE REHABILITATION – CAST-IN-PLACE CEMENTITIOUS LINER

7.1. GENERAL

7.1.1. Description of Work

This section covers the work necessary to structurally restore existing sanitary sewer manholes by installing a cast-in-place, thick wall, seamless concrete manhole within the existing manhole extending from the bench to the frame. These specifications represent **minimum** requirements and specifications for manhole rehabilitation. The CONTRACTOR shall abide any manufacturer's specifications that exceed these specifications.

7.1.2. Reference Standards

ASTM C 39	Standard Test Method for the Compressive Strength of Cylindrical Concrete Specimens
ASTM C 94	Standard Test Method for Ready Mix Concrete
ASTM C 143	Standard Test Method for Slump of Hydraulic Cement Concrete
ASTM D 149	Standard Test Method of Dielectric Breakdown Voltage And Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies
NACE RP0274	High Voltage Electrical Inspection of Pipeline Coating Prior to Installation

7.1.3. CONTRACTOR Submittals

7.1.3.1. All CONTRACTOR Project Submittals shall be submitted to MSD within 14 days of Notice to Proceed issuance. All submittals must be approved by MSD prior to the start of construction. Required submittals are as follows:

- A. Bypass Pumping Plan – shop drawing showing bypass pumping locations with sufficient detail to assure that the work can be accomplished without sewage spill, **if applicable**.
- B. Sample **Customer** Notification
- C. Equipment Failure Plan
- D. Third Party Testing Laboratory Credentials

- E. Traffic Control Plan including shop drawings and signage in accordance with MUTCD Guidelines
- F. Construction Calculations for liner thickness, including assumptions used in calculations
- G. Manufacturer Specifications for repair, manhole preparation and liner materials
- H. Construction Plan including the following submittals; details of all component materials, design mix and construction details including complete manufacturer's recommendations for storage procedures and temperature control, handling and applying the liner, curing details, service connection methods, trimming and finishing, sampling procedures, project schedule, and cleanup plan.
- I. Proof of applicator's qualification
- J. Manufacturer Specification and other information for plastic liners including, but not limited to, chemical resistivity, testing procedures and thickness.**

7.1.3.2. All submittals shall identify the specification section(s) they address.

7.1.4. CONTRACTOR Availability

7.1.4.1. The PRIME CONTRACTOR shall be on site during all phases of installation.

7.1.4.2. The CONTRACTOR shall have a local or 1-800 cellular phone or pager active at all times.

7.1.5. Project Documentation

7.1.5.1. The CONTRACTOR shall provide at least three acceptable **digital photos** of the manhole to be rehabilitated **by manhole number and photo number (example XXXXXX-X)**, as follows:

- A. Pre-rehab location photo showing identifying landmarks and manhole number.
- B. Pre-rehab photo(s) showing manhole defect(s).
- C. Post-rehab photo(s) of rehabilitated manhole (oriented identically to shot 2).
- D. Post-rehab external photo detailing the completed site work if site restoration is required. All external photos shall have the north side of the manhole clearly and consistently identified and all interior photos shall have the orientation identified as a clock reading with north being 12 o'clock.

7.1.5.2. The CONTRACTOR shall use the Manhole Rehabilitation Record Sheet presented in the special provisions section. All photos shall be placed in a three-ring binder(s) and delivered to the ENGINEER at the earliest possible date. An index shall be included with the each binder. The index shall include: corresponding photo number, contract number, street address where appropriate, record drawing number, CONTRACTOR name, location by station, and date.

7.1.5.3. Upon completion of installation, the CONTRACTOR shall update the **As-built drawings** to reflect the actual work performed and shall submit the completed **As-built drawings** to the MSD or its representative prior to acceptance testing.

7.1.6. Safety

7.1.6.1. It is the responsibility of the CONTRACTOR to conform to all applicable local, state and federal regulations including those of OSHA, RCRA and the EPA and any other applicable authorities.

7.1.6.2. The CONTRACTOR shall contact MSD's "Base 1" or other central dispatch point as designated by MSD at the Pre-construction meeting prior to and after leaving each manhole.

7.1.7. Public Notification

7.1.7.1. 72 hours prior to disruption of service, the CONTRACTOR shall notify property owners, public, residents, and all others who may be affected using a notification form approved by MSD.

7.1.7.2. The CONTRACTOR shall disrupt customer service for no longer than 12 hours. If service will be disrupted for more than 12 hours, the CONTRACTOR must notify affected customers and MSD of the delay and, if necessary, provide bypass pumping at no additional cost to MSD.

7.1.8. Quality Assurance

7.1.8.1. The resultant concrete interior shall be smooth and free of honeycomb and areas of segregated aggregate.

7.1.8.2. The new interior shall be inspected and tested according to the manufacturer's specification for cracks and thin spots. Any defects shall be promptly repaired and reinspected.

7.2. MATERIALS

7.2.1. Concrete

The material shall be a Type I/II Portland Cement concrete with 5/8 inch minus coarse aggregate with fiber reinforcement and plasticizers producing an average compressive strength of 4,000 psi at full cure.

7.2.2. Plastic Liner

7.2.2.1. When corrosive elements are present, a plastic liner shall be used. The plastic liner shall be a ribbed or studded plastic liner anchored into the new interior wall to create an impermeable barrier

7.2.2.2. The plastic liner shall be PVC, PE or other as best suited for the corrosion condition and compatibility with liner materials. **Acceptable manufacturers shall include, Ameron International (T-Lock), A-Lok (dura-plate), Poly-Triplex Technologies (poly-triplex liner), GSE (studliner) or approved equal.**

7.3. EXECUTION

7.3.1. General

Only manholes indicated on the drawings shall be rehabilitated, except as noted. The CONTRACTOR shall protect the manholes to withstand forces generated by equipment used during liner installation.

7.3.2. Bypass Pumping

7.3.2.1. Bypass pumping shall consist of furnishing, installing, and maintaining all power, primary and standby pumps, appurtenances and bypass piping required to maintain existing and peak hourly flows and services. The CONTRACTOR shall submit a plan for bypass pumping in accordance with MSD standards and the Special Provisions. The CONTRACTOR shall maintain bypass pumping until the protective coating has cured sufficiently for full flow to be reinstated without damage to the rehabilitated manhole.

7.3.2.2. Bypass pumping shall be done in such a manner as to not damage private or public property, or create a nuisance or public menace. The pumped sewage shall be in an enclosed hose or pipe that is adequately protected from traffic, and shall be redirected into the sanitary sewer system. Dumping or free flow of sewage on private property, gutters, streets, sidewalks, or into storm sewers is prohibited. The CONTRACTOR shall be liable for all cleanup, damages, and resultant fines in the event of a spill.

7.3.3. Cleaning and Preparation

7.3.3.1. The CONTRACTOR shall employ adequate cleaning to remove loose material and debris from the manhole. The CONTRACTOR shall capture, remove, and dispose of all waste materials related to cleaning that could potentially cause a sewer backup, damage existing facilities such as pump stations or cause sedimentation in the downstream sewer system.

7.3.3.2. Existing steps shall be removed as they might interfere with the erection of the forms and not re-installed. Precautions shall be taken to prevent foreign material from entering the active lines.

7.3.3.3. Infiltration shall be eliminated or reduced to an acceptable level as it may adversely affect placement of the concrete.

7.3.4. Equipment

Segmented, stackable steel forms shall be bolted together in cylindrical and conical sections with either eccentric or concentric cones or flat top ceilings and conform generally to the interior slope of the existing manhole.

7.3.5. Installation

7.3.5.1. All installation procedure, form sizing, erection, space between the forms and the existing wall concrete placing, overlaying of the bench and installation of plastic liner shall be according to the manufacturer's recommendations.

7.3.5.2. The form shall be positioned, sealed and finished at the manhole base to ensure concrete does not enter the sewer.

7.3.5.3. The concrete shall be carefully placed from the bottom up in such a manner as to prevent segregation of the cement and aggregate. The concrete shall be consolidated to fill all pockets, seams and cracks within the existing wall.

7.3.5.4. The form shall be disassembled and removed when the concrete has sufficiently cured to preclude slump or damage.

7.3.5.5. If the plastic liner is employed, it shall be fitted securely to the exterior of the steel forms during their erection within the manhole. When the forms are removed, any joints in the liner shall be welded and tested.

7.3.5.6. All pipe penetrations shall be sealed in accordance with the manufacturer's recommendations.

7.3.5.7. The frame and lid shall be handled and treated in accordance with the manufacturer's recommendations.

7.3.6. Testing and Inspection

All coated surfaces shall be spark tested for holes. The spark tester used shall provide 100 volts for every one (1) mil thickness applied but may be adjusted as necessary to detect the induced holiday, for example 25,000 volts for a 250 mil thickness lining. If pinholes are found, the CONTRACTOR shall repair the lining as recommended by the manufacturer and retest. All testing and repair work shall be at the CONTRACTOR's expense. The spark testing will be performed as specified herein and any repairs made prior to the final acceptance inspection.

A random sample of 20% of the project manholes shall be subject to vacuum testing in accordance with ASTM C1244. The total quantity of manholes to be tested shall be as specified in the contract special provisions and on the plan set. MSD or its representative shall randomly select the manholes to be tested such that they are spread evenly throughout the project area. The CONTRACTOR shall not be given advance notice of which manholes will be tested to ensure the integrity of the random test process.

Manholes shall be capable of holding a vacuum of 5 psi without dropping more than 0.5 psi for the times stated below:

Minimum test times for typical MSD manhole diameters (ASTM C1244-93)

Depth (ft)												
Diameter(in)*	8	10	12	14	16	18	20	22	24	26	28	30
	Times (s)											
48	20	25	30	35	40	45	50	55	59	64	69	74
60	26	33	39	46	52	59	65	72	78	85	91	98
72	33	41	49	57	67	73	81	89	97	115	113	121

*Refer to ASTM C1244 –99 for required test times on manholes with other diameters.

Manholes that do not pass the initial vacuum test shall be repaired and retested at no cost to MSD. In addition, for each manhole that fails the initial vacuum test, one additional manhole shall be tested at no additional cost to MSD. This process shall continue until a 100% pass rate is achieved.

7.3.7. Warranty

The CONTRACTOR shall provide MSD a warranty to be in force and effect for a period of five (5) years from the date of acceptance by MSD. The warranty shall require the CONTRACTOR to repair or replace the liner should leakage, separation, de-lamination, collapse, or other failure as determined by the ENGINEER result from faulty materials or installation.

SECTION 8

MSD STANDARD I/I SPECIFICATION

MANHOLE REHABILITATION – CURED-IN-PLACE MANHOLE LINER

8.1. GENERAL

8.1.1. Description of Work

This section covers the work necessary to restore existing sanitary sewer manholes utilizing a cured-in-place **manhole (CIPM)** liner. The **CIPM** liner system is formed from multiple structural fiberglass layers with a non-porous membrane bonded between the layers of fiberglass and molded to fit the manholes. The system shall provide an impervious water, chemical, and sewer gas resistant membrane and shall permanently adhere to wet or dry surfaces of brick, concrete, PVC and ductile iron. The **CIPM liner** shall prevent further deterioration, infiltration and exfiltration while providing reinforcement to the existing structure. These specifications represent **minimum** requirements and specifications for manhole rehabilitation. The CONTRACTOR shall abide by any manufacturer's specifications that exceed these specifications.

8.1.2. Reference Standards

ASTM D 638	Standard Test Method for Tensile Properties of Plastics
ASTM D 695	Standard Test Method for Compressive Properties of Rigid Plastics
ASTM D 990	Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
ASTM D 2240	Standard Test Method for Rubber Property-Durometer Hardness, Type D.
ASTM C 882	Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear
ASTM C 109	Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-inch [50-mm] Cube Specimens)
ASTM C 191	Test Method for Time of Setting of Hydraulic Cement by Vicat Needle
ASTM D 543	Test Method for Resistance of Plastics to Chemical Reagents
ASTM D 790	Test Methods for Flexural Properties of Plastics

ASTM D 4541 Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers

ASTM D 5813 Test Method for Chemical Resistance of Pipeline Coatings

8.1.3. CONTRACTOR Submittals

8.1.3.1. All CONTRACTOR Project Submittals shall be submitted to MSD within 14 days of Notice to Proceed issuance. All submittals must be approved by MSD prior to the start of construction. Required submittals are as follows:

- A. The CONTRACTOR shall submit the resin manufacturer's heating requirements and the **CIPM liner** manufacturer's curing requirements.
- B. Bypass Pumping Plan – shop drawing showing bypass pumping locations with sufficient detail to assure that the work can be accomplished without sewage spill, **if applicable.**
- C. Sample **Customer** Notification
- D. Equipment Failure Plan
- E. Third Party Testing Laboratory Credentials
- F. Traffic Control Plan including shop drawings and signage in accordance with MUTCD Guidelines
- G. **CIPM liner** thickness and shape **shall be in accordance with the manufacturer's recommendation for the specific application.**
- H. Manufacturer Specifications for repair, manhole preparation and **CIPM liner** materials as well as manufacturer certification that the materials are in compliance with the standards and codes referenced herein.
- I. Material Safety Data Sheets (MSDS) for each product used.
- J. Construction Plan including the following submittals; details of all component materials and construction details including complete manufacturer's recommendations for storage procedures and temperature control, handling and inserting the **CIPM liner**, curing details, service connection methods, trimming and finishing, material storage location, manufacturer installation specifications and procedures, sampling procedures, project schedule, and cleanup plan.
- K. Proof of applicator's qualification

8.1.3.2. All submittals shall identify the specification section(s) they address.

8.1.4. Equipment

Equipment used to impregnate resin, pressurize, heat the lining material and clean the manhole surface shall meet the requirements and specifications of the manufacturer.

8.1.5. CONTRACTOR Availability

8.1.5.1. The PRIME CONTRACTOR shall be on site during all phases of installation.

8.1.5.2. The CONTRACTOR shall have a local or 1-800 cellular phone or pager active at all times.

8.1.6. Project Documentation

8.1.6.1. The CONTRACTOR shall provide at least three acceptable **digital photos of the manhole to be rehabilitated by manhole number and photo number (example XXXXXX-X), as follows:**

- A. Pre-rehab location photo showing identifying landmarks and manhole number.
- B. Pre-rehab photo(s) showing manhole defect(s).
- C. Post-rehab photo(s) of rehabilitated manhole (oriented identically to shot 2).
- D. Post-rehab external photo detailing the completed site work if site restoration is required. All external photos shall have the north side of the manhole clearly and consistently identified and all interior photos shall have the orientation identified as a clock reading with north being 12 o'clock.

8.1.6.2. The CONTRACTOR shall use the Manhole Rehabilitation Record Sheet presented in the special provisions section. All photos shall be placed in a three-ring binder(s) and delivered to the ENGINEER at the earliest possible date. An index shall be included with the each binder. The index shall include: corresponding photo number, contract number, street address where appropriate, record drawing number, CONTRACTOR name, location by station, and date.

8.1.6.3. Upon completion of installation, the CONTRACTOR shall update the **As-built drawings** to reflect the actual work performed and shall submit the completed **As-built drawings** to the MSD or its representative prior to acceptance testing.

8.1.7. Quality Assurance

8.1.7.1. The finished **CIPM liner** system shall be continuous over the entire surface and shall be free from visual defects such as wrinkles, bulges, tears, crazing, foreign inclusions, dry spots, delamination, and pinholes.

8.1.7.2. The **CIPM liner** shall be a waterproof liner system that completely seals off all inflow and infiltration.

8.1.8. Safety

8.1.8.1. It is the responsibility of the CONTRACTOR to conform to all applicable local, state and federal regulations including those of OSHA, RCRA and the EPA and any other applicable authorities.

8.1.8.2. The CONTRACTOR shall contact MSD's " Base 1" or other central dispatch point as designated by MSD at the Pre-construction meeting prior to and after leaving each manhole.

8.1.9. Public Notification

8.1.9.1. 72 hours prior to disruption of service, the CONTRACTOR shall notify property owners, public, residents, and all others who may be affected using a notification form approved by MSD.

8.1.9.2. The CONTRACTOR shall disrupt customer service for no longer than 12 hours. If service will be disrupted for more than 12 hours, the CONTRACTOR must notify affected customers of the delay and, if necessary, provide bypass pumping at no additional cost to MSD.

8.2. MATERIALS

8.2.1. CIPM Liner System

- A. **The minimum allowable CIPM shall be composed of a multi-layered composite system meeting the requirements of Table 1 below. The CIPM system will incorporate layer(s) of structural fiberglass impregnated with modified epoxy resins and bonded to the existing substructure and a layer of non-porous PVC or membrane of special synthetic materials bonded together to protect the manhole from corrosion. There is no minimum or maximum manhole depth limit on this liner.**

**Table 1.
TEST PROPERTY VALUES**

ASTM D 695	
Compressive Strength	10,000 psi
Compressive Modulus	1,000,000 psi
ASTM D 638	
Tensile Strength	11,500 psi
Tensile Modulus	1,050,000 psi
Minimum Uncured Liner Weight	78 ounces per square yard
Minimum Field Cured Thickness¹	0.122 inches
ASTM D 2240	
Hardness	82 shore D
Epoxy Bond Strength	7,000 lbs
¹ See paragraph B for additional thickness requirement.	

- B. The CONTRACTOR shall assume external hydrostatic pressure on all manholes of 10 feet or the depth from the manhole invert to finished grade, whichever is less, and will include this measurement in determining liner thickness. In no cases shall liner be thinner than minimum field cured thickness required in Table 1. Calculations shall be stamped by a third-party Registered Engineer.**

- C. The design guide above is intended as a general manhole liner design guide and is not intended to limit the manufacturer's and authorized installer's judgment to use a heavier liner in determining the appropriate thickness and type of liners for individual structures based on the specific conditions encountered in each structure as authorized by the ENGINEER. Any variation of the above described liner type must be approved by the ENGINEER before Installer orders any material. Manufacturer or authorized installer shall not affect warranty requirement by using a thicker liner.**

- C. The liner shall be flexible, and have an elongation sufficient to bridge up to a 1/4- inch settling crack, without damage to the lining. The liner shall be able to bridge expansion cracks that may occur during its warranted life.**

- D. The CIPM liner must be impervious and without holes that will allow hidden corrosion on the concrete behind the liner, which can cause the eventual failure of the liner and the manhole.**

- E. **The CIPM liner system shall be applied by a qualified, licensed applicator/installer trained in handling and application of the materials and experienced with sizing CIPM liners to custom fit the manhole.**
- F. **Each liner shall be labeled by the liner manufacturer with the location of the liner manufacturer, name of the project, liner diameter, liner length, and the location where liner is to be installed.**
- G. **Approved manufacturers:**
 - 1. **Poly-Triplex Technologies**
 - 2. **Terre Hill Composites**
 - 3. **Or equal.**

8.3. EXECUTION

8.3.1. General

8.3.1.1. Only manholes indicated on the drawings shall be rehabilitated, except as noted.

8.3.1.2. All manhole rehabilitation work shall be performed or supervised by personnel experienced in the installation of the **CIPM liner** system as specified herein.

8.3.1.3. Exact measurements of each manhole to be rehabilitated shall be completed and submitted prior to manufacturing each **CIPM liner** as per the manufacturer's configuration measurements and other special notations and observations.

8.3.1.4. The **CIPM liner** shall be the type that allows rehabilitation of concentric, eccentric or flat top manholes without removing the manhole ring and top section, or corbel.

8.3.2. Bypass Pumping

8.3.2.1. Bypass pumping shall consist of furnishing, installing, and maintaining all power, primary and standby pumps, appurtenances and bypass piping required to maintain existing and peak hourly flows and services. The CONTRACTOR shall submit a plan for bypass pumping in accordance with MSD standards and the Special Provisions. The CONTRACTOR shall maintain bypass pumping until the protective coating has cured sufficiently for full flow to be reinstated without damage to the rehabilitated manhole.

8.3.2.2. Bypass pumping shall be done in such a manner as to not damage private or public property, or create a nuisance or public menace. The pumped sewage shall be in an enclosed hose or pipe that is adequately protected from traffic, and shall be redirected into the sanitary sewer system. Dumping or free flow of sewage on private property,

gutters, streets, sidewalks, or into storm sewers is prohibited. The CONTRACTOR shall be liable for all cleanup, damages, and resultant fines in the event of a spill.

8.3.3. Cleaning and Preparation

8.3.3.1. All surfaces of the manhole structure shall be cleaned with a high pressure hydro-jet sprayer with an operating pressure of at least 3,000 psi. After pressure cleaning, surface shall be cleaned with muriatic acid, degreaser or other solvents as needed in order to remove any film or residue on the surface. Structure shall then be pressure rinsed with water.

8.3.3.2. All contaminants including: oils, grease, unsound or incompatible existing coatings, waxes, form release, curing compounds, efflorescence, sealers, salts, or other contaminants shall be removed.

8.3.3.3. All incoming laterals and main trunk line openings shall be properly trimmed and grouted with hydraulic or Portland type II cement, forming a filet between the structure wall and each pipe. All inlet and outlet pipes shall be trimmed so they do not extend into the manhole more than two inches. Such application of grout shall extend at least six inches from the line outlet onto the wall area.

8.3.3.4. All inlet pipes, benches, and walls shall be repaired or refinished as appropriate using chemical grout, hydraulic cement or type II cement. Benches shall be lined with **CIPM Liner** System materials saturated with the epoxy resin and placed in the bottom and extending approximately 6 inches up the wall section, so as to overlap with the liner wall section.

8.3.3.5. The **CIPM liner** wet out procedure shall be conducted in a manner preventing wet out materials from contacting ground surfaces.

8.3.3.6. Steps interfering with the installation of the **CIPM liner** system shall be removed and not reinstalled.

8.3.3.7. The CONTRACTOR shall capture, remove, and dispose of all waste materials related to cleaning that could potentially cause a sewer backup, damage existing facilities such as pump stations or cause sedimentation in the downstream sewer system.

8.3.4. Installation

8.3.4.1. The **CIPM liner** shall be lowered into the structure to the pre marked position at the cover seat of the manhole entrance ring once it is fully saturated with the resin at the job site. The **CIPM liner** shall form a monolithic structure permanently connecting the ring and cover seat to the chimney, corbel, walls and benches. Unless otherwise required, the **CIPM liner** will end at the beginning of the invert. Invert channel lining will require that sewage flow be stopped for a period of 4-6 hours.

8.3.4.2. Upon completion of the **CIPM liner** curing process, the inflation bladder shall be removed and all lines reopened and the **CIPM liner** cut off at the manhole cover seat.

8.3.5. Curing

8.3.5.1. The CIPM liner shall be pressurized at a minimum of 500 lbs. per sq. ft. and heated by a temperature inversion system of pressurization with steam injection into the high velocity hot air column, creating a steam/convection oven atmosphere. This shall create a CIPM liner temperature of approximately 200 degrees Fahrenheit for the estimated one to two hours curing time according to the size and temperature of the structure.

8.3.5.2. The CONTRACTOR shall allow sufficient time for curing before reintroducing flow back into the manhole.

8.3.5.3. The curing process shall be in accordance with the **CIPM liner** system manufacturer's recommendations.

8.3.6. Testing

A random sample of 20% of the project manholes shall be subject to vacuum testing in accordance with ASTM C1244. The total quantity of manholes to be tested shall be as specified in the contract special provisions and on the plan set. MSD or its representative shall randomly select the manholes to be tested such that they are spread evenly throughout the project area. The CONTRACTOR shall not be given advance notice of which manholes will be tested to ensure the integrity of the random test process. Manholes shall be capable of holding a vacuum of 5 psi without dropping more than 0.5 psi for the times stated below:

Minimum test times for typical MSD manhole diameters (ASTM C1244-93)

Diameter (in)*	Depth (ft)											
	8	10	12	14	16	18	20	22	24	26	28	30
Times (s)												
48	20	25	30	35	40	45	50	55	59	64	69	74
60	26	33	39	46	52	59	65	72	78	85	91	98
72	33	41	49	57	67	73	81	89	97	115	113	121

*Refer to ASTM C1244 –99 for required test times on manholes with other diameters.

Manholes that do not pass the initial vacuum test shall be repaired and retested at no cost to MSD. In addition, for each manhole that fails the initial vacuum test, one additional manhole shall be tested at no additional cost to MSD. This process shall continue until a 100% pass rate is achieved.

All coated surfaces shall be spark tested for holes. The spark tester used shall provide 100 volts for every one (1) mil thickness applied but may be adjusted as necessary to detect the induced holiday, for example 25,000 volts for a 250 mil thickness lining. If pinholes are found, the CONTRACTOR shall repair the lining as recommended by the manufacturer and retest. All testing and repair work shall be at the CONTRACTOR's expense. The spark testing will be performed as specified herein and any repairs made prior to the final acceptance inspection.

8.3.7. Warranty

The CONTRACTOR shall provide MSD a warranty to be in force and effect for a period of five (5) years from the date of acceptance by MSD. The warranty shall require the CONTRACTOR to repair or replace the **CIPM liner** system should leakage, separation, collapse, or other failure as determined by the ENGINEER result from faulty materials or installation.

SECTION 9

MSD STANDARD I/I SPECIFICATION

CHEMICAL ROOT CONTROL

9.1. GENERAL

9.1.1. Description of Work

This section covers the work necessary to apply a chemical root control agent designed specifically to kill the root growth present in the lines and to inhibit root re-growth and sewer line intrusion without permanently damaging the vegetation producing the roots and without disrupting water treatment plant processes. These specifications represent **minimum** requirements and the CONTRACTOR shall abide any manufacturer specifications that exceed these specifications.

9.1.2. CONTRACTOR Submittals

9.1.2.1. All CONTRACTOR Project Submittals shall be submitted to MSD within 14 days of Notice to Proceed issuance. All submittals must be approved by MSD prior to the start of construction. Required submittals are as follows:

- A. Specimen labels with Material Safety Data Sheets
- B. Pollution Liability Insurance Certificate.
- C. CONTRACTOR qualifications including all related pesticide licenses and certifications.
- D. List of references, (minimum of 3).
- E. CONTRACTOR's Federal DOT number
- F. Evidence that the CONTRACTOR and all his subcontractors have obtained pollution liability coverage
- G. Traffic Control Plan including shop drawings and signage in accordance with MUTCD guidelines

9.1.2.2. All submittals shall identify the specification(s) they address.

9.1.3. Protection of Homes, Waste Water Treatment Plants and Receiving Waters

9.1.3.1. The CONTRACTOR shall prevent all chemical agents from reaching homes and businesses along the sewer cleaning route. Should any damage be caused to public or private property by the CONTRACTOR or his employees or agents, the CONTRACTOR will be required to make repairs immediately. The Owner may, however, elect to make repairs or replacement of damaged property and deduct the cost of such from monies due

or to become due the CONTRACTOR under this or any other contract with the Owner. All repair and/or replacement must be performed to the satisfaction of the Owner.

9.1.3.2. The CONTRACTOR shall take all steps necessary and appropriate to prevent adverse effects on wastewater treatment plants (WTP). Introduction of any materials in any WTP must be with the approval of the WTP operator. MSD has the right at any time to limit or stop chemical application in order to safeguard WTP processes. The CONTRACTOR shall provide the date and time of all intended work, name and telephone number of the CONTRACTOR's onsite supervisor, and provide any additional information requested by the operator.

9.1.3.3. The CONTRACTOR shall maintain daily communication with the WTP operator to assure that no adverse effects on WTP operations results from CONTRACTOR work.

9.1.3.4. The CONTRACTOR shall be financially responsible for any adverse effect on WTP processes directly or indirectly caused by chemical application, including but not limited to damages to plant processes or equipment, clean-up and restoration costs, fines imposed by State or Federal agencies, pollution of receiving waters, and civil suits. The CONTRACTOR shall further indemnify and hold harmless the Owner, and the operator of the wastewater treatment plant, against all costs, including legal expenses, relating to treatment plant failure or other damages or pollution caused, directly or indirectly, by the applications of chemicals by the CONTRACTOR.

9.1.4. Compliance with Transportation Laws

The CONTRACTOR is directed to ensure compliance with all USDOT regulations relative to commercial vehicle numbering, place carding and registration; driver licensing, driver drug testing, and record keeping; and all other pertinent requirements contained in Federal Motor Carrier Safety Regulations. The CONTRACTOR's Federal DOT number, if required, must be submitted as set forth in the Special Provision section.

9.1.5. Pollution Liability Insurance

9.1.5.1. The Pollution Liability Insurance described herein is in addition to all other insurance required of the CONTRACTOR by MSD, including any insurance described in the general conditions, any insurance required by law, or any other insurance requested by MSD.

9.1.5.2. The CONTRACTOR shall submit written evidence with the bid proposal that he and all his subcontractors have obtained pollution liability coverage as set forth in the Special Provision Section. This coverage shall protect the CONTRACTOR, MSD, and their officers, agents and employees from claims for damages for bodily or personal injury, sickness or disease, including death, and from claims for damages to property and/or the environment, which may arise directly out of the use of chemicals and/or pollution. The minimum amount of such insurance shall be \$1,000,000 total loss.

9.1.5.3. The CONTRACTOR's commercial general liability limits must be not less than \$3,000,000, total occurrence limit, and include pesticide or herbicide applicator coverage.

9.1.5.4. Nothing contained in this section shall be construed as limiting the extent of the CONTRACTOR's responsibility for payment of damages resulting from his operations under the contract.

9.1.6. CONTRACTOR Qualifications

9.1.6.1. The CONTRACTOR must demonstrate a minimum level of 3 years direct experience in applying chemical sewer root control of the type specified herein.

9.1.6.2. The CONTRACTOR must have treated in excess of 250,000 linear feet of sanitary sewer.

9.1.6.3. The CONTRACTOR must be licensed as a pesticide application business with the State Pesticide Regulatory Agency prior to submitting a bid proposal.

9.1.7. Project Documentation

9.1.7.1. Upon completion of the project and accompanying the invoice, or whenever requested to by MSD, the CONTRACTOR shall submit log sheets and reports which show, as a minimum, the following information:

- The name of the Owner
- The report date
- The date each given sewer line was treated
- Street name for each given sewer line
- A description (manhole numbers, house numbers, cross streets, etc.) which will enable the Owner to accurately identify the exact location of each sewer line
- The pipe size for each given sewer line
- The length (manhole to manhole) for each given sewer line
- Special conditions found by the CONTRACTOR's crew
- The date the guarantee expires on each given sewer line

9.1.7.2. The reports on completed work shall be submitted in two separate formats to assist MSD, as follows:

A. Arranged by Date Treated In order for MSD to easily determine and compare which sewer lines were treated on a given day, the CONTRACTOR will submit a complete set of completed work reports sorted on the date treated.

B. Arranged by Street Name In order for MSD to easily look up a particular street or sewer section, and determine particulars of the treatment, the CONTRACTOR will submit a complete set of reports sorted by street name.

9.1.7.3. The CONTRACTOR shall video inspect 10% - 15% of the total linear footage scheduled for root control prior to treatment. Lines to be inspected shall be identified by the ENGINEER. The video shall adhere to the requirements for pre-installation inspection videos for cured-in-place pipe work. **Digital** video inspection **documentation** shall be submitted to the INSPECTOR prior to treatment.

9.1.8. Substitutes and Proven Equivalents

Should the CONTRACTOR wish to use any brand of material other than as specified herein, he shall submit to MSD for review, complete descriptive literature naming the proposed substitution and manufacturer, as set forth in the Special Provision Section.

9.2. MATERIALS

9.2.1. Chemical Root Control

9.2.1.1. Chemical sewer root control treatment consists of two steps: root killing and root regrowth inhibition.

9.2.1.2. The chemical root control agent shall be registered with the EPA and the State Pesticide Regulatory Agency. Chemicals designed to be poured down, or blown into the pipe as a dust shall not be accepted.

9.2.1.3. Inert Ingredients. The root control material shall be formulated with foaming agents and surfactants sufficient to produce a stable, small bubble, dense foam capable of sustaining its shape and thus remaining on the treated roots. The foaming surfactants shall strip grease that typically clings to sewer root masses.

9.2.1.4. Root Killing Agent. The active component for destroying intruding roots in sanitary sewer lines shall be a potent, non-systemic toxin which kills contacted roots at low concentrations but which will not permanently **affect** parts of the plant distant from the treated roots. The active ingredient must be spontaneously detoxified by natural chemical or biochemical processes in a relatively short interval following its use. The active ingredient for destroying root intrusions shall be Sodium Methyldithiocarbamate, 2,6-Dichlorobenzonitrile (Dichlobenil) or approved equal.

9.2.1.5. Root Re-Growth Inhibitor. The active ingredient for inhibiting re-growth of root intrusions in sanitary sewer lines shall inhibit root cell growth on contact, but shall not be transported so as to damage other portions of the parent plant. The material shall bind firmly to the soil in the vicinity of openings in pipe joints so as to form a persistent chemical barrier suppressing the growth of root tips. The material shall be sufficiently stable under the conditions of use to provide protection for twelve months or longer, but shall be subject to decomposition in wastewater treatment plants without disturbing the treatment plant processes. The root cell growth inhibiting agent shall be 2,6-Dichlorobenzonitrile (Dichlobenil) or approved equal to be submitted as set forth in the Special Provision Section. A specimen product label(s) and Material Safety Data Sheets shall be submitted.

9.2.1.6. The chemical root control agent shall be registered with the EPA and the State Pesticide Regulatory Agency, and shall be labeled for use in sewers to control tree roots. Only materials whose label instructions conform to these specifications shall be accepted. All application procedures must be in strict conformance with these specifications and label instructions. Use of any root control herbicide in a manner inconsistent with labeled instructions is a violation of Federal law.

9.2.1.7. The active ingredient shall not adversely affect the performance of the wastewater treatment plant when applied properly in accordance with manufacturer's recommendations.

9.2.1.8. Compounds containing copper and/or other known priority pollutants, as defined by the Federal EPA, shall be disallowed.

9.2.2. Equipment

The equipment used shall discharge foam at sufficient pressure as to force foam up connecting lateral sewers approximately 5 feet in small diameter pipe. In no case shall chemical agents reach the home or businesses.

9.3. EXECUTION

9.3.1. Sewer Cleaning

9.3.1.1. Where sewer cleaning, grouting, or relining is specified or required, the foaming root control shall be performed a minimum of 60 days in advance of those operations, to maximize the biological decay of the root masses.

9.3.1.2. Sewer pipe cannot be treated effectively when surcharging flow conditions exist. If a surcharging condition exists on a sewer to be treated (i.e., flow depth is greater than 60% of the pipe diameter), the CONTRACTOR will return to treat that sewer when the flow is normalized. The CONTRACTOR is responsible for monitoring weather to ensure that lines are not treated when the possibility of surcharging due inflow and infiltration exist. If a sewer surcharges within a 12-hour period after a treatment has been made, the CONTRACTOR is will be required to retreat that section of sewer at the CONTRACTOR's expense if the surcharging is a result of CONTRACTOR activities or inflow and infiltration resulting from wet weather.

9.3.1.3. If a sewer section is surcharged, at the time of treatment, due to a blockage, the CONTRACTOR will relieve the blockage. The CONTRACTOR shall wait at least 60 days after any cleaning work is performed in order to allow root tissues to recover, prior to treating the sewer line.

9.3.1.4. If excessive accumulations of dirt, grease, or other debris preclude effective treatment of a sewer line, the CONTRACTOR shall clean the sewer pipe prior to treatment. This work will be performed at the CONTRACTOR's discretion, and the CONTRACTOR's sole expense. As stated above, the CONTRACTOR shall wait at least 60 days after any cleaning work is performed, in order to allow root tissues to recover, prior to treating the sewer line.

9.3.2. Applications

9.3.2.1. Application of the chemical root control agent shall be by foaming in accordance with the best-recommended practice for conditions present in the line under treatment. All foaming procedures shall be in strict accordance with the instructions on the container label.

9.3.2.2. A foam discharge hose shall be inserted throughout the entire length of the sewer section to be treated. Acceptable methods of conveying the foam discharge hose through the sewer section are: 1) manually or mechanically shoving the foam discharge hose through the section, or 2) floating a rope through the sewer section and using the rope to pull the foam discharge hose into the section.

9.3.2.3. The foam shall be pumped under sufficient pressure to assure that the entire sewer section is completely filled with foam, and to assure that the foam passes through lateral pipe connections to a distance of 5 feet in small diameter pipe. Sewer service to homeowners shall not be interrupted nor shall chemical agents reach the home or business. The CONTRACTOR must beware that excessive discharge pressure, and/or excessive quantities of material may cause foam to enter houses, or travel up forward clean-outs onto lawns.

9.3.2.4. Hose retrieval rates must be timed to evenly distribute the full quantity of foam throughout the entire area of treatment.

9.3.3. Notifications

The CONTRACTOR shall provide 48-hour notice to MSD prior to starting work on any portion of the contract. All work shall be performed during normal business hours observed by MSD. Work during other hours, weekends, or holidays observed by MSD, may only be performed with permission from MSD. MSD reserves the right to inspect all work as it is performed, and to reject any work that in the opinion of MSD is defective in workmanship and materials. In the event that the work schedule proposed by the CONTRACTOR places MSD at an inconvenience with respect to the inspection of the work, MSD may require the CONTRACTOR to halt or delay the work, reduce the number of crews on the job, or take any other steps deemed necessary by MSD to enable MSD to exercise the right to inspect.

Each day, prior to application, the CONTRACTOR must contact MSD or MSD's designated agent to assess wet-weather conditions. Formal procedures for this contact will be set prior to construction. MSD reserves the right to stop chemical treatment if weather conditions may result in high flows. Failure by MSD to execute this right does not responsibility of the CONTRACTOR for re-treatment due to surcharged conditions within 12 hours of application.

9.3.4. CONTRACTOR Responsibilities

9.3.4.1. Should any chemical root control agent spill on the ground, the chemical and affected soil shall be removed and safely disposed of. The CONTRACTOR shall handle all spill in accordance with the appropriate Material Safety Data (M.S.D.) sheets and shall have on site materials and equipment to contain and handle spills. The area shall be restored to a condition equal to or better than before the spill. Any damage to vegetation resulting from misuse of the chemical root control agent shall be the responsibility of the CONTRACTOR.

9.3.4.2. CONTRACTOR shall respect the rights of property owners, and not enter upon private property without obtaining permission from the owner of the property.

9.3.4.3. CONTRACTOR shall place proper traffic warning devices to protect the specific job site, and to prevent accidents or personal injury to the public. Police protection and/or flagmen for safe traffic control shall be provided by the CONTRACTOR as conditions dictate or when so directed by MSD. Some line sections may be located in heavy traffic areas.

9.3.4.4. CONTRACTOR shall keep complete, accurate records of each day's operation. Records shall show date of treatment, sections of line treated, pipe size and distance, and other pertinent information. Log sheets shall be submitted with the invoice.

9.3.4.5. CONTRACTOR shall return within 4 to 8 months after the work is completed, and periodically throughout the life of the guarantee, in order to evaluate the success of the project, and to arrange any free guarantee work that may arise. This inspection shall be performed at no additional expense to MSD.

9.3.4.6. CONTRACTOR shall be responsible for insuring that handling, transportation, and use of any hazardous materials, and disposal of all pesticide containers, are according to the State and Federal regulations pertaining thereto.

9.3.4.7. The CONTRACTOR shall be responsible for obtaining permits and meters from the Louisville Water Company for water supply and paying for all water usage.

9.3.5. Television Inspection

9.3.5.1. The CONTRACTOR shall perform **TVI** inspection of 12.5% +/- 2.5% of the total linear footage of pipe scheduled for treatment. TVI shall be performed in the presence of the MSD INSPECTOR. TVI shall be conducted using pivot head cameras and identify all root intrusions into the pipe and at property service connections using **NASSCO PACP** coding. Suitable logs and **digital** video shall be provided to the INSPECTOR prior to performing root control. The CONTRACTOR shall perform a follow up **digital** video inspection of the same lines between 6 and 8 months of treatment date. This TVI shall be conducted in the same direction as the original inspection. Acceptable root kill must be demonstrated with the TVI for project acceptance. In the event that the TVI can not demonstrate acceptable kill, samples of suspect root tissue shall be made and analyzed by the local county extension office to determine if the root is dead.

9.3.6. Warranty

For each sewer section (manhole-to-manhole) that is treated under the Contract, the CONTRACTOR shall guarantee the work as follows.

9.3.6.1. At the option of MSD, the CONTRACTOR shall, at his own expense, re-treat a sewer section, or refund 100% of the payment received to treat that section, in the event that: (1) live roots are found in the section within six months after the application; or, (2)

the section plugs up and floods due to tree root obstructions within a period of two years, beginning the date of treatment, and ending two years after the date of treatment.

9.3.6.2. The guarantee applies only to sewer stoppages caused by live tree roots. It does not apply to stoppages caused by grease or other foreign matter; flat, collapsed or deformed pipe; or flooding caused by a surcharged or plugged sewer section downstream from a guaranteed sewer section. **The decision of MSD as to the cause of a stoppage is binding.**

9.3.6.3. The CONTRACTOR shall be required to return periodically (every 4 to 8 months), at the CONTRACTOR's sole expense, for the purpose of performing free re-treatments as required under the guarantee.