

STANDARD SPECIFICATIONS
SECTION 02955
SEWER MAINS AND LATERAL REHABILITATION BY LINING

PART 1 GENERAL

1.1 DESCRIPTION

- A. Section includes requirements for reconstruction of sewer mains and laterals by Cured in Place Pipe (CIPP) lining and installation of a resin-impregnated flexile tube.

1.2 DEFINITIONS

- A. Mainline: Sewer main.
- B. Lateral: Service pipe from property line to mainline.
- C. Lateral-Mainline Interface: Lateral connection to mainline.
- D. Lateral-Mainline Interface Seal: Watertight seal between lateral and mainline.
- E. Re-instate Lateral-Mainline Interface: Cutting open or trimming opening in mainline liner to allow flow from lateral to enter main.

1.3 QUALITY ASSURANCE

- A. Follow national standards and as specified herein.
- B. Personnel Involved in Installation of Pipe Liner: Certified by liner manufacturer successfully completed training in handling, insertion, trimming, reinstatement of laterals and finishing pipe liner.
- C. Engineer:
 - 1. May inspect and test liner or its materials at factory, before delivery to site or while in storage.
 - 2. May inspect factory materials, wet-out procedure, and loading.
- D. Internally inspect host pipe prior to lining and post-lining.
- E. Commercially Proven Mainline and Lateral Products:
 - 1. Minimum 500,000 linear feet mainline and 3,500 linear feet laterals successfully installed and documented in the United States and Internationally.
 - 2. Translate International installations into English to Commission's approval.
- F. Commercially Proven Lateral-Mainline Interface Product:

1. Minimum 1,000 lateral-mainline interface services successfully installed and documented in the United States and Internationally.
2. Translate International installations into English to Commission's approval.

1.4 SUBMITTALS

- A. Submit following Section 01330.
 1. Working drawings showing design calculations, soil impacts, live load, dead load, ground water impacts, materials selected, and thickness of liner.
 2. Catalog data showing manufacturer's clarifications and updates, ASTM references, material composition, specifications, physical properties and chemical resistance of liner.
 3. Manufacturer's recommended procedures for handling, storing, repairing, and installing materials selected.
 4. Method of construction.
 - a. Access manholes and site locations.
 - b. Work dimensions.
 - c. Existing utilities.
 - d. Size of working area.
 - e. Impacted portions of existing sewer.
 - f. Site access points.
 - g. Bypass pumping plan: Follow Section 02960.
 5. Emergency plan detailing procedures followed in event of health and safety emergency, pump failures, sewer overflows, service backups, and sewage spillage. Maintain copy on site for duration of project.
 - a. Address dangers associated with sewer rehabilitation work (i.e. working with large boiler trucks).
 - b. Identify Health and Safety officer (i.e. crew chief)
 - c. Designated Health and Safety officer:
 - 1) Responsible for providing health and safety oversight of personnel participating on project team.
 - 2) Perform and document routine work area inspections, conduct safety meetings, and provide safety orientations for team members.
 - 3) Have in easily accessible place following contact information;
 - a) Non emergency number.
 - b) Contractor's health and safety representative name and number.
 - c) Occupational health clinic number(s).
 - d. Submit for review the following;
 - 1) List of critical rehabilitation equipment, including boiler truck equipment, to be inspected on daily basis.
 - 2) Recently completed (previous month) monthly maintenance log.
 - 3) Annual third-party certified inspection for boiler truck(s) to be used on project.
 - 4) Certification of training for boiler truck operator.

6. Method of reinstatement and sealing of lateral-mainline interface including, but not limited to internal inspection equipment, and equipment used for reinstatement and sealing of lateral-mainline interface.
 - a. Air testing not required for lateral-mainline interface seal installed utilizing the Janssen resin injection system or a full wrap profile, i.e., LMK T-Liner that extends from sewer main to sewer house connection cleanout.
 7. Infrared spectrograph chemical fingerprint and Certificates of Analysis for each lot of resins:
 - a. Lot number.
 - b. Product name.
 - c. Manufacturer.
 - d. Brookfield Viscosity.
 - e. Thix Index.
 - f. Gel time at cure temperature.
 - g. Peak temperature for failure.
 - h. Percent of non-volatile solids.
 - i. Specific Gravity.
 - j. Catalyzed Stability time at optimum temperature.
 - k. Catalyst to resin ratio.
 - l. Analysis signature.
 - m. Date tested.
 - n. Batch ticket for each resin-catalyst-colorant batch made up and impregnated into felt liner material.
 8. Stock sheets, order forms, delivery forms, invoices, and Hazardous Material forms for material used.
 9. Shipping manifest with;
 - a. Date shipped.
 - b. Origination and delivery locations.
 - c. Shipping method and carrier.
 - d. Shipping order number.
 - e. Purchase order number.
 - f. Shipped item.
 - g. Stock number.
 - h. Lot number.
 - i. Manufacturer.
 - j. Any shipping, storage, or safety requirements.
 - k. Received by, and date.
 - l. Signature of receiver.
- B. Submit following Section 01450 and specified herein. Mark submittals with mainline pipe identification number, work order number, Contract number, Contractor's name, operator's name, and date of readings.
1. Certified statement from manufacturer approved installer of their system.
 - a. Include certificates of training for each crewmember involved in installation process.

2. Documentation for Products and Installers: Engineer's approval required before installation of liner.
3. ASTM certified lab test results for field installations in United States of same resin system and tube materials as proposed for actual installation.
 - a. Test results must verify (CIPP) physical properties specified herein have been achieved in previous field applications.
 - b. Third party is defined as ASTM or equivalent accredited materials testing firm with no financial or directorial link to manufacturer or Contractor.
4. Television inspection reports, color videos, CD-ROMs, and electronic CIMS 2000 downloads made before and following mainline CIPP, and original copies of digitally recorded inspections furnished to Engineer within 10 days.
5. Curing logs: Include liner manufacturer recommended curing citations for each submittal. Store electronically on data logger. Submit printed copy with Post CCTV.
 - a. Heat cured liners.
 - 1) Record temperature (degrees Fahrenheit) and pressure (psi) readings per unit of time collected during liner installation and curing.
 - b. UV cured liners.
 - 1) Record the curing speed (feet per minute), light source (number of lamps, intensity and wattage), inner air pressure (psi), and curing temperatures (degrees Fahrenheit) per unit time over length of liner.
6. Weiring Logs: Show beginning and final rehab weir readings.
7. Materials delivery and storage: Record date, time and temperature readings at 15 minute intervals, minimum. Include sewer pipe material's stock identification number.
8. Tabulation of time versus temperature by liner manufacturer with lengths of time exposed portions of liner will endure without self-initiated cure or other deterioration.
 - a. Tabulate at 5 degrees F. increments, ranging from 70 degrees F. to 100 degrees F.
 - b. Include analysis of progressive effects of such self-initiated cure on insertion and cured properties of liner.
9. Provide to Engineer for review within 30 days prior to beginning work;
 - a. Description of methods for avoiding liner stoppage due to conflict and friction with such points as manhole entrance and bend into pipe entrance.
 - b. Plans for dealing with liner stopped by snagging within pipe.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect, store, and handle materials during transportation and delivery, while stored on-site, and during installation following manufacturer's recommendations.
- B. Continuously monitor liner materials during transport and storage with temperature recorder and data storage or strip printer.
 1. Furnish Engineer with recorder readings before installation.
 2. Material exposed to temperatures outside of manufacturer's limits: Rejected.

- C. Material found to be defective or damaged due to manufacture or shipment:
1. When Engineer deems repairable: Repair following manufacturer's recommendations.
 2. When Engineer deems not repairable: Rejected, removed from Contract site, and replaced under Engineer's direction.
 3. Repair or replacement of defective or damaged material will be at no additional cost to Commission.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Mainline (CIPP): Follow ASTM F1216, ASTM F1743 and ASTM F2019 as appropriate to insertion method, liner tube material and resin material proposed for fully deteriorated pipe condition.
1. Wet-out liner material in controlled factory environment.
 2. Resin-Catalyst-Colorant-Additive Mixture:
 - a. Tested to certify liner material follows design standards before wet out.
 - b. Quantity of resin used for tube impregnation: Sufficient to fill volume of air voids in felt tube with additional 10 to 15 percent allowances for polymerization shrinkage and loss of resin through cracks and irregularities in original pipe wall.
 - 1) Heat cured liners, required amount of resin mixture: Vacuumed into felt liner material.
 - a) Point of vacuum: No further than 25 feet from point of initial resin introduction to ensure thorough resin saturation throughout length of felt tube.
 - b) Vacuum point: No further than 75 feet from leading edge of resin after vacuum in tube is established.
 - 2) UV cured liners, fiberglass liner: Saturated with appropriate resin using resin bath to minimize air entrapment and delivered to site ready for installation.
 - a) Vacuum methods: Not permitted for introducing resin in UV cured fiberglass liners.
 - 3) Leading edge of resin slug:
 - a) As near to perpendicular as possible.
 - b) Wet-out liner is fed onto conveyor system and through roller gap set following design (minimum 2.3 x lining thickness in mm).
 - (1) Ensure uniform distribution of resin throughout pre-cured liner.
 - (2) Pack pre-cured liner on ice within automatically monitored refrigerated truck with ice bags between pre-cured liner folds.
 - c) Alternate resin impregnation method: Proven, inspected, and with Engineer's approval.
 - c. Colorant: Dark yellow.
 - 1) Add to catalyst before mixing catalyst with resin.

- 2) Pigmentation: Produces color that is clearly distinguishable from dry felt.
- 3) Wall color of interior pipe surface of CIPP after installation: Light reflective color to allow clear detailed examination with closed circuit television inspection equipment.
3. Additives for resin enhancement, viscosity control, safety, chemical resistance, physical resistance, or extending shelf life are permitted with Engineer's approval.
4. Liner Tube.
 - a. Felt Tubes.
 - 1) Seams as described herein.
 - a) Liner to run continuously from manhole to manhole.
 - b) Does not use overlapping section of liner felt tube or longitudinal seams that cause lumps in final product.
 - 2) Impermeable, flexible membrane outside layer that will contain resin and monitor resin saturation at factory during resin impregnation procedure.
 - b. Fiberglass Tubes.
 - 1) Consist of seamless, spirally wound fiberglass flexible up to 10 percent expansion.
 - a) Longitudinal stitched. Stitch free weld or bond or stitch free overlap is not permitted.
 - 2) Fiberglass tube: Include exterior and interior film that contains resin in tube, are impervious to airborne styrene and serves as ultraviolet blocking material.
5. Cured Liner: 50-year life span.
 - a. Chemically resistant to internal exposure to sewage containing small quantities of hydrogen sulfide, carbon dioxide, methane, mercaptans, kerosene, moisture, and diluted sulfuric acid.
 - b. Chemically and physically resistant to external exposure of soil bacteria, moisture, roots, and chemical attack, that may be due to material in surrounding ground.
6. Approved Manufacturers:
 - a. Inliner Technologies, LLC.
 - b. Insituform Technologies Inc.
 - c. National Liner.
 - d. Novapipe.
 - e. Premier Pipe.
 - f. Reline America Blue-Tek Liner.
 - g. Saertex MultiCom.
 - h. Or equal.

B. Lateral CIPP Renewal Processes:

1. ASTM F2561-06 or ASTM F1216 following mainline CIPP wet-out requirements.

C. Lateral-Mainline Interface Seal:

1. ASTM F2561-06 following mainline CIPP wet-out requirements.
 - a. T Liner.

- 1) Approved manufacturers.
 - a) LMK Enterprises Inc.
 - b) Or equal.
2. Resin injection process following manufacturer's recommendations.
 - a. Injected resin.
 - 1) Approved manufacturers:
 - a) Janssen Process Company.
 - b) Or Equal.
3. Follow Section 02959 for lateral-mainline interface sealing by chemical grout.

D. Cleanout Installation.

1. Vacuum excavated vertical tee pipe.
 - a. Four inch diameter vertical pipe attached with watertight seal.
 - b. Approved manufacturers.
 - 1) LMK Vac-a-Tee.
 - 2) Jed Saddle Clean-out.
 - 3) Or equal.

E. Miscellaneous Materials.

1. Finishing material for transitioning, filling, and sealing liners entering manholes.
 - a. Chemically inert, non shrinking, and able to cure in presence of water.
 - b. Material: Quickset H₂S resistant, epoxy resin or mortar.
 - c. Design mix: Minimum 500-psi compressive strength in 28 days.
 - 1) Additives may be added to improve flow properties when minimum compressive strength requirements are met, with Engineer's approval.
 - d. Pre-lining lateral installations: Use PVC Tees with full circle seal couplers on either side of PVC Tee.
 - 1) PVC Tee: Stainless steel sleeve inside lateral tap to protect tap during reinstatement.
 - e. Pre-lining external point repairs: Use PVC pipe with non-shear seal couplers on either side of PVC pipe.
 - f. Non-shear couplings: Capable of maintaining mainline alignment during mainline lining.
 - g. Epoxy resin used to seal liner to manhole drop line: Compatible with liner.

F. CIPP Liner Calculations.

1. Layers of cured CIPP: Uniformly bonded.
 - a. Structural Properties: Use deteriorated design condition, following design equations in appendix of ASTM F1216. If equation is less than minimum liner thickness noted on table below use minimum as noted.
 - 1) Design Assumptions.
 - a) Water table: At manhole rim
 - b) Buckling resistance: AWWA M45, Appendix A
 - c) Design Safety Factor: 2.0
 - d) Ovality: 2 percent
 - e) Live Load: H20 Highway

Felt Liner and Ambient Temperature, Steam or Hot Water Cured CIPP	
Host Pipe Diameter	Minimum Liner Thickness
8" diameter	6 mm
10" diameter	6 mm
12" diameter	8 mm
15" diameter	10 mm
18" diameter	12 mm

Fiberglass Felt and Ultraviolet Cured CIPP	
Host Pipe Diameter	Minimum Liner Thickness
8" diameter	4 mm
10" diameter	4 mm
12" diameter	6 mm
15" diameter	6 mm
18" diameter	8 mm

2.2 SOURCE QUALITY CONTROL

A. Mainline Cured-In-Place Pipe (CIPP)

1. Document installation procedure following ASTM F1216, ASTM F1743 or ASTM F2019, as appropriate to insertion method, liner tube material, resin material, curing method and installation procedures, as specified herein, for Engineer's approval.
2. Submit 10 percent of lining coupon samples to independent third party laboratory for testing with verification following ASTM F1216, Section 8 Inspection Practices or ASTM F2019, Table 1, as appropriate to liner tube and resin materials. Testing will include;
 - a. Short Term Flexural (Bend) Properties.
 - b. Tensile Properties.
 - c. CIPP Wall Thickness.
3. Submit results from independent third party laboratory for Engineer's approval.
 - a. Correct rejected deficiencies at no additional cost to the Commission.
4. Perform Post-inspection CCTV recording following Section 02956 for Engineer's approval.
 - a. The acceptability of lateral liner defects will be at Engineers discretion. Defect locations will factor into Engineers decision on acceptability.
 - b. Liner Approved:
 - 1) Free of wrinkles.
 - 2) Continuous liner over length of reconstructed pipe.
 - 3) No visible leaks.
 - 4) Free of obstructions.
 - c. Rejected: Correct deficiencies at no additional cost to the Commission.

- B. Lateral Renewal Process.
1. Lateral Renewals by CIPP:
 - a. Document installation procedure following manufacturer's recommendation, ASTM standards F1216 or F2561-06 and as specified herein for Engineer's approval.
 - b. Collect Mainline and Lateral Cured In-Place Lining (MLCIPL) samples for 10 percent of installed laterals and submit to independent third party laboratory for testing with verification following ASTM F1216, Section 8 Recommended Inspection Practices.
 - 1) Short –Term Flexural Properties.
 - 2) MLCIPL Wall Thickness.
 2. Rehabilitation of lateral-mainline interface by resin injection seal.
 - a. Record and document installer's certificate of training number and manufacturer's batch identification number.
 - b. Mark identification number on corresponding resin sample (5 to 6 ounce cubes) poured at start of each new batch at beginning of each day.
 - c. Submit 10 percent of prepared samples to independent third party laboratory for testing under Engineers direction.
 - 1) If half of samples fail, additional 10 percent may be required to be tested.
 - d. Record resin injection process with CCTV for Engineer's approval. Follow Section 02956.
 - e. Cure: Follow manufacturer's recommendation.
 - f. Clearly see resin ring at lateral-mainline interface.
 3. Submit results from independent third party laboratory for Engineer's approval.
 4. Perform Post-inspection CCTV recording following Section 02956 for Engineer's approval.
 - a. Acceptability of lateral liner defects: Engineers discretion. Defect locations will factor into Engineers decision on acceptability.
 - b. Approved:
 - 1) Free of wrinkles.
 - 2) Continuous liner over length of reconstructed pipe.
 - 3) No visible leaks.
 - 4) Free of obstructions.
 - c. Rejected: Correct deficiencies at no additional cost to the Commission.
- C. Lateral-Mainline Interface.
1. Rehabilitation of lateral-mainline interface by lining specified herein.
 - a. Follow Mainline CIPP for sample submissions, reviews, results, and corrections.
 2. Rehabilitation of lateral-mainline interface by resin injection seal.
 - a. Record and document installer's certificate of training number and manufacturer's batch identification number.
 - b. Mark identification number on corresponding resin sample (5 to 6 ounce cubes) poured at start of each new batch at beginning of each day.
 - c. Submit 10 percent of prepared samples to independent third party laboratory for testing under Engineer's direction.

- 1) If half of samples fail, additional 10 percent may be required to be tested.
 - d. Record resin injection process with CCTV for Engineer's approval. Follow Section 02956.
 - e. Cure: Follow manufacturer's recommendations.
 - f. Clearly see resin ring at lateral-mainline interface.
3. Follow Mainline CIPP for review and correction process.

PART 3 EXECUTION

3.1 PUBLIC NOTIFICATION

- A. Following Section 02950.

3.2 TESTING

- A. Follow Section 01450 and as directed by Engineer.
- B. Post Installation Test:
1. Ensure materials installed follow specifications and test site is safe, accessible, ventilated and well lighted.

3.3 MAINLINE PREPARATION

- A. Access: Through existing manholes.
- B. CCTV Internal Inspection.
1. Perform after cleaning sewer: Follow Section 02956 and specified herein.
 - a. Pre-lining recordings: Indicate mainline is ready for lining.
 - b. Engineer approval of pre-lining recordings: Required prior to liner installation.
 2. Pre-Lining internal intruding tap and offset joint removal.
 - a. Remove, by internal process, intruding taps and offset joints that reduce internal diameter of liner by 10 percent or more.
 - b. Perform Pre-Lining external point repair if internal removal efforts fail to remove an obstruction.
 3. Pre-Lining Mandrel.
 - a. Insert and pull mandrel through mainline to be lined following Section 02530 to demonstrate that mainline can accept liner.
 - b. Repair areas where mandrel cannot pass before lining is performed.
 4. Pre-Lining Installation of External Point Repairs and Lateral Renewals following Section 02530 and specified herein.
 - a. Excavate and repair defects in host pipe, which could include intruding laterals and offset joints that cannot be repaired by internal means.
 - 1) PVC pipe external point repairs: Sized to match mainline interior diameter with equivalent exterior diameter for seal clamp to fit.

- b. Remove sags and flow constrictions that reduce cross-sectional area of mainline more than 10 percent.
- c. Remove trapped debris that jetting cannot remove.
- d. Clear mainline of dropped joints, crushed or collapsed pipe, and other obstructions that interfere with installation, causes damage to inverted tube, or reduces capacity of sewer.
- e. Perform lateral renewals that involve a new tap.
 - 1) PVC Tee Connection: Sized to match mainline and lateral interior diameter with equivalent exterior diameter for seal clamp to fit.

C. Infiltration Leakage Measurement and Control.

- 1. Immediately before lining mainline and after by-pass has been established, measure infiltration in isolated mainline using a weir.
- 2. Stabilize flow through weir for 10 minutes before taking measurement.
- 3. Repeat weir measurement immediately after lining while bypass is still in place.
- 4. Report pre-lining and post lining measurements to Engineer upon completion of lining operation.
- 5. Where needed, perform pre-lining leakage control by chemical grout method to eliminate cold spots.

3.4 MAINLINE LINER INSTALLATION.

A. Set up bypass pumping, if necessary, or turn off water to building with Engineers approval.

- 1. Water service shutdown will be reviewed by Engineer on case by case basis.
 - a. Public notification: Follow Section 02950.

B. Method of Lining.

- 1. Invert tube by inversion: Follow ASTM F1216
 - a. Erect scaffold or elevated platform at upstream or downstream access point.
 - b. Invert pre-cured tube using inversion elbow at bottom of manhole or inversion ring above ground with water pressure.
 - 1) Ensure tube is;
 - a) Fully extended to termination point and expanded to inside pipe diameter with no annular space between liner and host pipe.
 - b) Dimpled to show locations of service laterals needing restoration.
- 2. Pull-In Place: Follow ASTM 1743, F2019.
 - a. Install slip sheet on bottom half of pipe prior to liner insertion. Pull liner into place with constant tension winch capable of recording strain used during insertion.
 - b. Use end plugs to cap each end of liner. Both plugs and liner restrained during pressurization of line.
 - c. Measure laterals for reinstatement.
- 3. Use hydrophilic water stop around exterior of liner material at liner termination in each manhole to prevent passage of groundwater infiltration past liner termination, regardless of insertion methodology used.

4. Other methods of installation of CIPP lining or curing are acceptable, provided manufacturer and installer demonstrate they meet Quality Assurance requirements specified herein and obtain Engineers approval following Substitution Procedures, Section 01630.
- C. Install and cure resin impregnated tube into liner: Follow manufacturer's recommendations and specified herein.
1. Protect tube and lining material from damage during installation.
 2. Insert tube without twisting, cutting, tearing, separating, kinking, gouging, overstressing, resin loss, or double-ups.
 3. Engineer may request installed tube be retrieved for inspection.
 4. If tube is damaged during removal, repair tube to Engineer's approval or replace damaged tube with new tube at no cost to the Commission.
- D. Loss or discharge of resin, other lining materials, or by-products downstream is not permitted.
1. Stop, collect, and remove at next downstream manhole.
 2. Transportation and disposal of debris: Follow jurisdiction requirements and as approved by Engineer.
- E. Notify Engineer of any construction delay, problems, or contract deviations taking place during insertion before curing operations.
1. Such delays or problems may require sampling and testing of portions of cured liner by independent laboratory at Engineer's direction at no additional cost to the Commission.
 2. Sample test failures or lack of immediate notification of delay may result in rejection of that portion of work.
 3. Engineer has option to require removal of liner tube and reinstallation.
 4. If tube is damaged during removal, repair tube to Engineer's approval or replace damaged tube with new tube at no cost to the Commission.
- F. Cure.
1. Liners cured with hot water or steam: Follow ASTM F1216 or ASTM F1743 as specified.
 - a. Recirculation Equipment: Capable of uniformly raising temperature of re-circulated water, and maintaining recommended cure temperature for duration to produce cured resin.
 - b. Water/Steam Temperature in Tube during Cure Period: Follow manufacturer's guidelines and specified herein.
 - 1) Follow minimum and maximum standards for curing CIPP including temperature requirements determined by resin/catalyst system employed.
 - 2) Bring temperature up slowly through stages until exothermic reaction is achieved and then maintain.
 - a) Evidence of exothermic reaction: When inspection of exposed portions of CIPP appear hard and sound and sensor indicates

2. Fiberglass Liners cured with UV: Follow ASTM F2019.
 - a. Cure with UV light sources at constant inner pressure sufficient to maintain liner tight against existing wall of pipe.
 - b. Record time, rate of travel of ultraviolet light assembly, light sources and internal pressures as specified by liner manufacturer.
 - c. Submit segment curing data to Engineer along with manufacturer's curing standards.

G. Process Monitoring Sensors.

1. Use to monitor and maintain curing temperature and internal pressure throughout length of liner following manufacturer's recommendations.
2. Heat Source: Fitted with suitable monitors to gauge temperature of incoming and outgoing heat exchanger circulating water.
3. Placement: Between tube and host pipe in downstream manhole at or near bottom.
 - a. Extra temperature gauges: Inside tube at invert level of each end.
4. Electronically record continuous or specified pressure and temperature reading on printout.
 - a. Start time.
 - b. Gradual build up to curing period with maximum temperature and pressure.
 - c. Time of gradual dropping of curing temperature.
 - d. Cool down duration along with relaxing temperature and pressure.
 - e. Start time of gradual release of curing pressure.
 - f. Ending time.
5. If electronic recording fails, record temperature and pressure readings on log every 10 minutes starting before pressure is added to liner and ending 20 minutes after pressure is relieved.
6. Provide digital thermometer or other means of accurately and quickly checking temperature of exposed portions of liner.

H. Cooling and Relaxation of Liners:

1. Cool finished CIPP to temperature within 10 degrees of ambient temperature before relieving static head in inversion standpipe.
2. Cool-down may be accomplished by introduction of cool water into standpipe to replace water/steam being drained or vented from downstream end.
3. Caution is advised in release of static head so vacuum will not be developed with potential to damage newly installed liner.
4. After liner has cooled and relaxed, except for manhole indicated as line-through, cut cured liner flush with inside wall of manholes.
5. Fill voids between manhole channel, bench, or wall and liner with quick setting, H₂S resistant, epoxy mortar to form watertight seal.
6. Trowel grout to form smooth transition between manhole base or channel and liner to ensure sewage flow with no collection points for solids.

I. Finish liner.

1. Ensure liner is continuous over length of reconstructed pipe and follows material requirements specified herein.
2. Repair leaks at interface of manhole and liner.

J. Return mainlines to service with approval of Engineer.

3.5 MAINLINE DROP CONNECTIONS AT MANHOLES

- A. Replace existing exterior drops with inside drop connections following Section 02530, Standard Details and specified herein.
1. Line through drop and open up extended liner into manhole enough to clamp inside drop fittings, using mold to maintain pipe outside form and diameter.
 2. If manhole is brick, remove and provide new precast manhole with inside drop connection following Standard Details.

3.6 RE-INSTATEMENT OF LATERAL-MAINLINE INTERFACE

- A. Identify and locate lateral-mainline interface.
- B. Re-instate active services and services to vacant lots after pipe liner has cured.
1. Perform from interior of pipeline without excavation using internal inspection camera with robotic cutter head.
 2. Re-instatement cut through liner: Neat, smooth, and to diameter of existing lateral-mainline interface in order to prevent blockages.
 3. Do not damage existing laterals.
 4. Coupons and cuttings.
 - a. Collect at downstream manhole and remove.
 - b. Mark whole captured coupons with component number and make available for testing and reporting liner thickness.
- C. Abandoned Laterals.
1. Open at Engineer's directions.
 2. If abandoned lateral is opened without Engineer's approval, perform an internal spot repair to close lateral at no cost to the Commission.
- D. Lateral-Mainline Interface Reinstatement Problems.
1. Respond within 2 hours of Engineer's notification of potential backup.
 2. Cost incurred by the Commission due to failure to respond within time frame specified may be deducted from monies owed Contractor.

3.7 PREPARATION FOR LATERAL LINING

- A. Access: Through mainline connection or cleanout.
- B. Lateral lining ability inspection.

1. Rate connecting laterals by inspection between main and cleanout or beyond property line.
2. Do not line laterals with less than 2 percent grade, deep sags, offsets, heavy grease, un-removable roots, over 2 multiple bends, capped end, un-sealable leaks, PVC material, crushed/collapsed lateral pipe, and without manufacturer's recommendation.
3. Laterals that cannot be lined: Renew following Section 02530 and Standard Details.
4. Submit to Engineer, documentation and video for laterals that cannot be lined.

C. Cleanout.

1. Install if there is no existing cleanout or existing cleanout needs repair.
 - a. If replacing existing cleanout, install assembled cleanout stack in same off-property location.
2. Installation method.
 - a. Vacuum excavation.
 - 1) Excavate pit 24 inches maximum diameter to depth of lateral pipe following manufacturer's recommendation
 - 2) Install cleanout vertical tee pipe.
 - a) Apply curing epoxy on underside of saddle at thickness of .2 inches or 5mm. Epoxy: Able to cure in presence of water.
 - b) Saddle to snap fit by compression over 50% of host pipes outside diameter.
 - c) Conduct water tight test using minimum water column height of 6 feet.
 - (1) Shallow laterals: Install sufficient amount of vertical pipe to accommodate 6 foot water column.
 - d) Core through the host lateral.
 - b. Open cut excavation.
 - 1) Install following Section 02530 and Standard Detail with Engineer's approval.

D. Lateral Cleaning and Surface.

1. Internally remove any obstructions, roots, debris, and grease that will impact lining lateral.
2. Remove tuberculation from ductile iron laterals.
3. Do not back-up or blow-back water into property owners' building.
4. Laterals, mainlines, or property damaged as result of improper use of cleaning and preparation equipment to be repaired at no cost to the Commission.

E. Inspection and Recommendation to Engineer.

1. Inspect laterals from mainline or cleanout pit.
2. Identify laterals ready for lining.
3. Install lateral lining only after pre-lining CCTV inspections following Engineer's review and approval.

- F. Setup bypass pumping, if necessary, or turn off water to building with Engineer's approval.
 - 1. Water service shutdown will be reviewed by Engineer on case by case basis.
 - a. Public Notification: Following Section 02950.
- G. Perform manufacturers and industry standard required preparation work to alleviate lateral lining problems.

3.8 LATERAL LINING INSTALLATION

- A. Follow procedures for Mainline Liner Installation, specified herein.
- B. Invert tube from process launcher by controlled means, assuring even feed of tube into lateral with installation pressure not exceeding 10 to 15 psi.
- C. Place lateral liner no greater than 6 inches from lateral-mainline interface.
- D. Place lateral liner over all defects or within 12 inches from cleanout.
- E. Use multiple CCTV cameras to ensure proper installation and alignment of lateral liner.
- F. When curing is completed, gradually reduce pressure and remove inflation bladder including any leftover pieces.
- G. Ensure liner is continuous over length of reconstructed pipe and meets or exceeds material requirements specified herein.
- H. Inspection.
 - 1. Materials and processes: Reasonably available for pre-installation, installation and post-installation inspections.
 - 2. Areas that require inspection include, but are not limited to product materials exhibiting sufficient transparency to visually verify quality of resin impregnation.

3.9 LATERAL RENEWAL

- A. New Lateral: Open cut. Follow Section 02530.
 - 1. PVC
- B. Installation of approved lateral system using an approved manufacturer.

3.10 LATERAL-MAINLINE INTERFACE SEAL

- A. After mainline lining is completed, install watertight lateral-mainline interface seal and extend minimum of 18 inches into lateral to create water tight seal ensuring interface is smooth and does not impede flow from lateral.
 - 1. T-Liner type lateral lining system (shorty)
 - 2. Janssen Process Company.

- B. Perform manufacturer's required and industry standard preparation work to alleviate lateral-mainline interface seal problems and as specified herein.
 - 1. As necessary for access of equipment, contour manhole bench and channel by saw cutting.
 - 2. Internally remove any obstructions, roots, debris, or grease that impact lateral-mainline interface seal.
 - 3. Remove tuberculation on ductile iron lateral.
 - 4. Do not back-up or blow-back waste into property owners' building.
 - 5. Perform pre-lining leakage control by chemical grout method to eliminate cold spots.
 - a. Chemical grouting not required for Janssen resin seal method.
 - 6. Lateral, mainline, or property damaged as result of improper use of equipment: Repaired at no cost to the Commission.

- C. Setup bypass pumping, if necessary, or turn off water to building with Engineer's approval.

3.10 POST INSPECTION OF MAIN, LATERAL, AND LATERAL-MAINLINE INTERFACE

- A. Follow Section 02956 and specified herein.

- B. Verify system is sealed and free of leaks.
 - 1. Show liner at manhole wall is sealed with no leakage.
 - 2. Show main, lateral, and lateral-mainline interface seal are installed properly.

3.11 ACCEPTANCE

- A. Inspect sewer main, lateral, and lateral-mainline system by CCTV inspection.

- B. Infiltration of groundwater: None.

- C. Laterals: Reinstated and unobstructed.

- D. Defects When Engineer Deems Repairable: Repair defect, replace liner, install new service, or replace lateral-mainline interface at no additional cost to the Commission.

3.12 ADDITIONAL WORK ORDERS

- A. Additional Work Orders may be issued and may be designated as emergency.

- B. Commence emergency work within 24 hours of issuance.

PART 4 MEASUREMENT AND PAYMENT

4.1 MAINLINE PIPE LINER

- A. Measurement: By linear foot measured horizontally along centerline of mainline lined.
- B. Payment: At unit price for each size listed in Bid Schedule.
 - 1. Payment includes Pre-Lining cleaning and reaming intruding taps, Pre-Lining CCTV inspection, Post-Lining CCTV inspection, weir readings, mandrel testing, bypass pumping, permanent restoration, labor, materials and equipment necessary to install liner as specified.

4.2 LATERAL PIPE LINER

- A. Measurement: By linear foot measured horizontally along centerline of lateral lined from cleanout to lateral-mainline interface.
- B. Payment: At unit price listed in Bid Schedule.
 - 1. Payment includes Pre-Lining cleaning and CCTV inspections, Post-Lining CCTV inspection, Pre-Lining leakage control, bypass pumping, lateral mainline interface seal, permanent restoration, permanent repair of manhole bench and channel, labor, materials and equipment necessary to install liner specified herein.

4.3 RE-STATEMENT LATERAL-MAINLINE INTERFACE

- A. Measurement: By each lateral-mainline interface reopened internally after mainline is lined.
- B. Payment: At unit price listed in Bid Schedule.
 - 1. Payment includes CCTV inspection, labor, materials, equipment, and testing necessary to re-instate (open) service after main lining.

4.4 LATERAL-MAINLINE INTERFACE SEAL WITH NO LATERAL LINING

- A. Measurement: By each active lateral-mainline interface sealed at lateral that was not lined.
- B. Payment: At unit price listed in Bid Schedule.
 - 1. Payment includes cleaning, Pre-CCTV inspection, Post CCTV inspection, pre-interface seal leakage control, bypass pumping, permanent restoration, permanent

4.5 CLEANOUT BY VACUUM EXCAVATION

- A. Measurement: By each complete in place.
- B. Payment: At unit price listed in Bid Schedule.
 - 1. Payment includes vacuum excavation, backfill, bedding, pipe, fittings, and connection to service.

*WSSC**