

SECTION 02767

RELINING EXISTING SANITARY SEWERS WITH
RESIN IMPREGNATED FLEXIBLE FELT TUBEPART 1 GENERAL

101. WORK INCLUDED

- A. Resin impregnated flexible felt tube.
- B. Cleaning of existing sewer lines.
- C. Closed circuit television inspection.
- D. Bypassing sewage.
- E. Removal of line obstructions.
- F. Access pits.
- G. Installation.
- H. Sealing liner at manholes.
- I. Lateral sewer connections.
- J. Inside drop structures.
- K. The CONTRACTOR shall provide all materials, labor, equipment, tools, etc., and perform all required work and services necessary for and incidental to a complete installation as shown on the PLANS and/or called for in the SPECIFICATIONS in complete accord with the CONTRACT DOCUMENTS.
- L. All supplementary or miscellaneous items, equipment, appurtenances, or devices necessary for or incidental to a complete and functional installation, whether or not shown on the PLANS or addressed in the SPECIFICATIONS, shall be provided and installed as part of the WORK.

102. SYSTEM DESCRIPTION

- A. This section covers the reconstruction of sanitary sewer lines by the installation of a resin impregnated flexible felt tube inverted into the existing sewer line utilizing a vertical inversion standpipe and hydrostatic head.
- B. This section also covers the reconstruction of sanitary sewer service laterals by the installation of a resin impregnated flexible felt tube from inside the main sewer or through a cleanout or other access point in the lateral.
- C. Curing shall be accomplished by circulating hot water or other approved method to cure the resin into a hard impermeable pipe.
- D. When cured, the lining shall extend over the length of the inversion in a continuous tight fitting watertight pipe-within-a-pipe.

103. PATENTS AND LICENSES

- A. The method of relining existing sanitary sewers and service laterals specified herein is a patented process installed by contractors approved and licensed by Insituform Technologies, Inc.
- B. The CONTRACTOR and his sureties shall assume all responsibility for damage arising through infringements of patent rights connected with any or all of the materials, appliances, articles, or systems used in the performance of this WORK and shall pay all royalties on apparatus or methods installed by him.
- C. The CONTRACTOR shall be responsible for determining the application of patent rights and royalties on materials, appliances, articles, or systems prior to bidding.

104. SUBMITTALS

- A. Provide shop drawings and/or manufacturer's literature fully describing the selected product.
- B. Provide manufacturer's recommended handling, storage, and instructions.
- C. Provide copies of the inspection log to be maintained during the closed circuit television inspection.

105. DELIVERY, STORAGE, AND HANDLING

- A. Box, crate, or otherwise completely protect all equipment and materials during shipment, handling, and storage.
- B. Store all equipment and materials above ground.
- C. Protect from exposure to the elements and keep all items thoroughly dry at all times. Protect from exposure to excessive heat and direct sunlight. Secure all materials against wind damage.
- D. Protect from mud, stains, discoloration, abuse, abrasion, impact, corrosion, deterioration, and other damage.
- E. Store in such a manner as to prevent distortion to equipment, materials, and supporting structures.
- F. Repair or replace damaged equipment, materials, or structures.

106. QUALIFICATIONS OF CONTRACTOR

- A. The installing CONTRACTOR or SUBCONTRACTOR shall be approved and licensed by Insituform Technologies, Inc. to install resin impregnated flexible felt tube by the methods specified herein and in accordance with the procedures recommended by Insituform Technologies, Inc.
- B. The installing CONTRACTOR or SUBCONTRACTOR shall have been regularly engaged in relining existing sanitary sewers with resin impregnated flexible felt tube for a minimum of five (5) years as of the date of opening BIDS for this CONTRACT.
- C. Upon request by the ENGINEER, the installing CONTRACTOR or SUBCONTRACTOR shall provide a list of at least five (5) similar projects for which they relined existing sanitary sewers with resin impregnated flexible felt tube. The names of references for these projects shall be provided. References should be restricted to North Carolina installations as far as practical. If

less than five (5) installations have been made in North Carolina, then list five (5) installations that are closest to the project site. All referenced installations shall have been completed for at least one (1) full year as of the date of opening BIDS for this CONTRACT.

107. METHOD OF MEASUREMENT

- A. The quantity of cleaning of existing sewer lines to be paid for shall be the actual number of linear feet of the various sizes of sewer line as measured on the land surface from manhole to manhole which have been cleaned and accepted.
- B. The quantity of closed circuit television inspection to be paid for shall be the actual number of linear feet of sewer line as measured on the land surface from manhole to manhole which have been inspected and accepted.
- C. The quantity of relining existing sanitary sewers with resin impregnated flexible felt tube to be paid for shall be the actual number of linear feet of the various sizes of pipe as measured on the land surface from manhole to manhole which have been incorporated into the completed and accepted work.
- D. The quantity of relining existing sanitary sewer service laterals with resin impregnated flexible felt tube to be paid for shall be the actual number of linear feet of the various sizes of pipe as measured along the centerline of the service lateral pipe from the inside wall of the sanitary sewer main up through and to the top of the lateral cleanout which have been incorporated into the completed and accepted work.
- E. The quantity of point repairs to be paid for shall be the actual number of point repairs for each depth range as shown in the BID SCHEDULE which have been authorized by the ENGINEER, completed, and accepted. Depths shall be measured from the existing pipe invert to the existing ground surface at the point of repair. Payment shall not be made for point repairs which are not required due to locating an access pit at the point requiring repair.
- F. The quantity of inside drop structures to be paid for shall be the actual number of drop structures of the various sizes and depth ranges as shown in the BID SCHEDULE which have been completed and accepted. Depths shall be measured from the existing manhole invert to the existing ground surface at the manhole.

108. METHOD OF PAYMENT

- A. Payment for RELINING EXISTING SANITARY SEWERS WITH RESIN IMPREGNATED FLEXIBLE FELT TUBE shall be at the CONTRACT UNIT PRICE per unit as measured above for each item as shown in the BID SCHEDULE under the following payment categories.
 - 1. CLEANING OF EXISTING SEWER LINES
 - 2. CLOSED CIRCUIT TELEVISION INSPECTION
 - 3. RELINING EXISTING 8" SANITARY SEWER WITH RESIN IMPREGNATED FLEXIBLE FELT TUBE, minimum thickness = 0.236 inches.
 - 4. RELINING EXISTING 4" SANITARY SEWER SERVICE LATERAL WITH RESIN IMPREGNATED FLEXIBLE FELT TUBE, minimum thickness = 0.157 inches.
 - 5. POINT REPAIRS
 - 6. INSIDE DROP STRUCTURE

- B. The above prices and payments as specified in the BID SCHEDULE shall be full compensation for all work covered by this section including, but not limited to: cleaning of existing sewer lines, closed circuit television inspection, removal of line obstructions, bypassing sewage, access pits, excavation, bedding, backfill, resin impregnated flexible felt tube, liner insertion, curing, cool down, sealing liner at manholes, lateral sewers, and inside drop structures.

PART 2 PRODUCTS

201. RESIN IMPREGNATED FLEXIBLE FELT TUBE

- A. The felt tube shall be fabricated from materials which when cured will be chemically resistant to withstand internal exposure to domestic sewage containing high concentrations of hydrogen sulfide and the accompanying accumulations of sulfuric acid (up to 25% concentration).
- B. The felt tube shall be fabricated to a size that when installed will neatly fit the internal circumference of the conduit to be relined. Allowance shall be made for circumferential stretching during installation.
- C. The minimum length shall be that necessary to effectively span the distance from the inlet to the outlet of the respective manholes for main sewers and from the lateral connection at the main sewer to the desired termination location in service lateral pipes. The CONTRACTOR shall verify lengths in the field before resin impregnation. 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.
- D. Unless otherwise specified, the CONTRACTOR shall furnish a general purpose, unsaturated, polyester resin and catalyst system that meets Insituform Technologies, Inc. standards and the finished cured physical strengths specified herein.
- E. The cured lining shall have a minimum flexural strength of 4,500 psi and a minimum modulus of elasticity of 250,000 psi when tested in accordance with Insituform Technologies, Inc. Standard 101 (modified ASTM D790).

202. INSIDE DROP STRUCTURE MATERIALS

- A. Pipe and fittings shall be solvent welded polyvinyl chloride (PVC) manufactured in complete accordance with and meeting the test requirements of one of the following ASTM Specifications:
1. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedule 40.
 2. ASTM D2655 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste and Vent Pipe and Fittings.
- B. Flexible elastomeric pipe fittings and adapters shall be as manufactured by Fernco, or approved equal.

203. BEDDING AND BACKFILL MATERIALS

- A. Bedding
1. Bedding material shall be Class I in accordance with ASTM D2321. ASTM C33 No. 57 gradation stone is acceptable bedding material.

2. Bedding material shall extend up the sides of the pipe to the top of the pipe.

B. Initial Backfill

1. Initial backfill between the bedding and a horizontal plane twelve (12") inches above the top of the pipe shall be in conformance with ASTM D2321 and shall be one or a combination of the following class materials:
 - a. Class I - ASTM C33 No. 57 (1" to 1½") gradation stone.
 - b. Class II - Coarse sands and gravels with maximum particle size 1½" including variously graded sands and gravels containing small percentages of fines, generally granular and non-cohesive, either wet or dry. Soil type (ASTM D2487) GW, GP, SW and SP are included in Class II.
 - c. Class III - Fine sand and clayey gravels, including fine sands, sand-clay mixtures, and gravel-clay mixtures. Soil types GM, GC, SM and SC are included in Class III.

C. Backfill

1. Native soil may be reused to backfill excavations provided that said soil is free of lumps, clods, boulders, rocks or other foreign matter and that said soil may be placed in accordance with the compaction requirements of these SPECIFICATIONS.
2. Borrow.

204. MASONRY

- A. All masonry shall conform to the requirements of NCDOT SSRS Section 1040 except bricks shall be clay or concrete bricks conforming to ASTM C32 Grade MM and ASTM C55 Grade S-II respectively.

205. CONCRETE

- A. Concrete shall be in conformance with NCDOT SSRS Section 1000, except concrete shall be 3000 psi concrete, Class A.

PART 3 EXECUTION

301. PROTECTION

- A. All construction shall comply with all safety regulations and safeguards for the safety and protection of all persons within the construction area. Erect and maintain all work in a safe and stable condition.
- B. Protect excavations by shoring, bracing, sheet piling, underpinning, or other methods required to prevent cave-in or loose soil from falling into the excavation.
- C. Protect existing landscaping, trees, structures, fences, pavements, curbs, gutters, bench marks, utilities, and other features which are to remain.
- D. Repair all damages. All features disturbed shall be restored to conditions as good as or better than originally existed.

302. PREPARATION

- A. Establish and verify required lines, levels, grades, and datum.
- B. Identify and flag known utilities.
- C. Notify and coordinate with utility owner to have conflicting utilities removed and/or relocated.

303. CLEANING OF EXISTING SEWER LINES

- A. Clean all sewer lines to be relined prior to television inspection utilizing personnel thoroughly familiar with all phases of sewer line cleaning.
- B. Select cleaning equipment based on the condition of the lines. Equipment shall be mechanically powered or hydraulically propelled. Equipment selected shall be subject to approval by the ENGINEER.
- C. Take all necessary precautions to protect the sewer system from damage due to cleaning operations.
- D. When using hydraulic cleaning methods, take necessary precautions to prevent damaging or flooding public and private property being serviced by the sewer system.
- E. Remove all sludge, dirt, sand, rock, sediment, grease, roots, obstructions, and other deleterious solid and semisolid materials from the sewer lines and manholes. Remove these materials at manholes in the section being cleaned. Do not pass such materials from section to section. When cleaning hydraulically, use a weir or dam in the downstream manhole to trap all solid material.
- F. Dispose of all removed waste materials and debris at a site provided by the CONTRACTOR in full compliance with all Federal, State, and local laws, ordinances, rules, and regulations. Utilize watertight vessels to convey waste materials to the disposal site. Do not dump or spill sewage or solids onto ground surfaces or into ditches, manholes, catch basins, or storm drains. Immediately clean up any accidental spills and restore contaminated areas to their original condition.

304. CLOSED CIRCUIT TELEVISION INSPECTION

- A. Promptly after cleaning a section of line, inspect the pipe interior by closed circuit television methods utilizing equipment specifically designed for pipeline inspection. Inspection personnel shall be experienced in locating breaks, obstacles, and service connections by closed circuit television. Determine the location of service connections and any conditions which might prevent proper installation of the liner.
- B. Record the television inspection on video tape and keep the tape until the expiration of the CONTRACT warranty period.
- C. Maintain an inspection log of observed conditions and submit a copy of the log to the ENGINEER prior to beginning relining. The inspection log shall contain the following items:
 - 1. OWNER'S name.
 - 2. Project name and number.

3. Dates of cleaning and inspection.
4. Names of inspectors and technicians.
5. Weather conditions.
6. Location of line including manhole numbers.
7. Distances between manholes.
8. Direction of view and measurement.
9. Pipe size, material, and type of joint.
10. General Observations:
 - a. Pipe condition.
 - b. Joint condition.
 - c. Manhole condition.
 - d. Cleanliness.
 - e. Presence of scale, corrosion, or erosion.
11. Location and description of:
 - a. Breaks.
 - b. Obstructions.
 - c. Deflections from straight alignment (vertical and horizontal).
 - d. Points of infiltration.
 - e. Points of root intrusion.
 - f. Other items of interest.
12. Location, size, type (tap, tee, or wye), and condition of service laterals.

305. REMOVAL OF LINE OBSTRUCTIONS

- A. Clear the pipeline of obstructions such as solids, misaligned joints, protruding service connections, or collapsed pipe that will prevent the installation of the liner.
- B. If an obstruction cannot be removed by conventional sewer cleaning equipment, make a point repair access excavation to uncover and remove or repair the obstruction. Do not make point repairs except in the presence of the ENGINEER.
- C. A point repair shall be defined as repair work within a section of existing sewer line not exceeding twenty (20') feet in length where an access excavation is required in order to make the repairs.
- D. Repairs shall permit insertion of the liner and be structurally sound.

306. BYPASSING SEWAGE

- A. Bypass sewage around the section of line to be relined by plugging an upstream manhole and pumping the sewage into a downstream manhole or adjacent system. Pumps and bypass lines shall have adequate capacity to handle the flow.
- B. Do not dump or spill sewage on public or private properties at any time. Immediately clean up any accidental spills and restore contaminated areas to their original condition.
- C. Provide temporary tie-ins between the sewer system and relined sections at the end of each working day.

307. EXCAVATION

- A. Place excavated material alongside the excavation so as not to obstruct any drain or unnecessarily obstruct any passageway.
- B. Grade excavation top perimeter to prevent surface water runoff into excavation.
- C. Provide temporary drainage as required.
- D. Maintain access to hydrants, water valve boxes, fire alarm boxes, and mail boxes at all times.
- E. Excavated materials not required for fill or backfill shall be removed and disposed of off-site in an approved location provided by the CONTRACTOR.

308. BACKFILL

- A. Verify that work has been properly and correctly completed prior to backfilling.
- B. Verify that areas to be backfilled are free of debris, deleterious obstructions, snow, ice, or water, and surfaces are not frozen.
- C. Adequately support pipe during placement and compaction of bedding and initial backfill, maintaining line and grade.
- D. Employ a placement method so as not to disturb or damage the pipe line.
- E. The dropping of earth or backfilling from the top of the ground surface to the bottom of the excavation will not be permitted.
- F. Place and compact backfill materials in continuous layers not exceeding six (6") inches loose depth.
- G. Hand deposit and compact sufficient bedding material under the pipe haunches and on each side of the pipe to hold the pipe in proper position during subsequent backfilling operations. Deposit bedding material uniformly and simultaneously on each side of the pipe to prevent lateral displacement.
- H. Initial backfilling to a minimum depth of twelve (12") inches above the top of the pipe shall be carefully placed by hand.
- I. Initial backfilling to a minimum depth of twelve (12") inches above the top of the pipe shall be compacted by vibrators, hand tools, lightrrollers, tampers, or other similar compactors.

- J. No heavy machinery such as hydrohammers shall be used directly over pipe until a minimum of two (2') feet cover is in place above the top of the pipe.
- K. Backfill to previously existing contours and elevations. Backfill systematically, as early as possible, to allow maximum time for natural settlement. Do not backfill over porous, wet, or spongy subgrade surfaces.
- L. Remove surplus backfill materials from site.
- M. Correct settlement.
- N. Borrow shall be used under all driveways and roads if natural subsoil cannot be compacted to within limits.
- O. Moisten and/or aerate backfill material as necessary to adjust the moisture content to within two (2%) per cent of the optimum moisture content and to achieve the required compaction and structural stability.
- P. Backfill within three (3') feet of any structure, i.e., manhole, etc., shall be compacted to ninety-eight (98%) percent Standard Proctor throughout the depth of the backfill. The backfill shall be uniformly deposited on all sides as above and solidly tamped in such a manner as to avoid injuring the structure on producing unequal pressures on the structure.
- Q. Backfill within all traffic ways shall be compacted to ninety-eight (98%) percent Standard Proctor throughout the depth of the backfill.
- R. Backfill in all other areas shall be compacted to ninety (90%) percent Standard Proctor throughout the depth of the backfill.
- S. Compaction testing shall be performed as required by the ENGINEER.

309. RESIN IMPREGNATION OF LINER

- A. The CONTRACTOR, subject to approval of the ENGINEER, shall designate a location where the uncured resin in the original containers and the unimpregnated fiber felt tube will be vacuum impregnated prior to installation.
- B. The ENGINEER and OWNER shall have the right to inspect all materials and "wet out" procedures.
- C. Resin shall be applied at rates which will provide the wall thickness shown on the PLANS or in the BID SCHEDULE.

310. INSERTION OF LINER IN SEWER MAINS

- A. The wet out fiber felt tube shall be inserted through an existing manhole or other approved access by means of an inversion process and the application of a hydrostatic head sufficient to fully extend it to the next designated manhole or termination point.
- B. The impregnated tube material shall be inserted into the vertical inversion standpipe with the impermeable plastic membrane side out.
- C. At the lower end of the inversion standpipe, the felt tube shall be turned inside out and attached to the standpipe so that a leakproof seal is created.

- D. The inversion head shall be adjusted to be of sufficient height to cause the impregnated tube to invert from manhole to manhole and hold the tube tight to the pipe wall, produce dimples at side connections and flared ends at the manholes.
- E. The use of a lubricant is recommended and, if used, such lubricant shall be as recommended by Insituform Technologies, Inc..

311. INSERTION OF LINER IN SERVICE LATERALS

- A. The wet out fiber felt tube shall be installed by either the inversion method from the main sewer or the pull-in method from a cleanout or access point.
- B. Insertion by the inversion method shall be as follows:
 1. The wet-out tube shall be loaded inside a pressure apparatus above ground.
 2. The pressure apparatus, with an end attached to a robotic device, shall be winched through the main sewer to the service connection.
 3. The robotic device, together with a television camera, shall be used to position the pressure apparatus' inversion elbow at the service connection opening.
 4. The inversion head shall be adjusted to be of sufficient pressure to cause the impregnated tube to invert completely in the lateral pipe and hold the tube tight to the pipe wall.
 5. Air pressure, supplied to the pressure apparatus through an inversion hose, shall be used to invert the wet-out tube through the lateral pipe.
- C. Insertion by the pull-in method shall be as follows:
 1. The wet-out tube shall be attached to a pull cable strung from the lateral and main sewer to the downstream manhole.
 2. The tube will be pulled through the lateral so that the end ring projects into the main.
 3. The tube shall be firmly seated against the main sewer wall by pulling back on the end of the tube.
 4. The tube shall be inflated with water or other appropriate medium to fully expand the tube and press it firmly against the wall of the lateral.

312. CURING OF IN-PLACE LINER

- A. Care shall be taken during the curing process so as not to damage or overstress the liner.
- B. After inversion is completed the CONTRACTOR shall supply a suitable heat source and water recirculation equipment. The equipment shall be capable of delivering hot water throughout the section by means of a pre-strung hose to uniformly raise the water temperature above the temperature required to effect a cure of the resin. This temperature shall be determined by the resin/catalyst system employed.
- C. The heat source shall be fitted with suitable monitors to gauge the temperature of the incoming and outgoing water supply. Another such gauge shall be placed between the impregnated felt tube and the pipe invert at the remote manhole to determine the temperatures during cure. Water temperature in the line during the cure period shall be as recommended by the resin manufacturer.

- D. Initial cure shall be deemed to be completed when inspection of the exposed portions of the liner appear to be hard and sound and the remote temperature sensor indicates that an exotherm has occurred. The cure period shall be of a duration recommended by the resin manufacturer, as modified for the Insituform process, during which time the recirculation of the water and cycling of the heat exchanger to maintain the temperature shall continue.
- E. The CONTRACTOR shall cool the hardened liner pipe to a temperature below 100°F before relieving the static head in the inversion standpipe. Cool-down may be accomplished by the introduction of cool water into the inversion standpipe 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 be developed.
- F. The finished liner pipe shall be continuous over the entire length of an inversion run and be free from visual defects such as foreign inclusions, dry spots, pinholes and delamination. It shall also meet the leakage requirements or pressure test specified below. All defects shall be repaired at the CONTRACTOR'S expense in a manner approved by the ENGINEER.

313. SEALING LINER AT MANHOLES

- A. If the completed lining has failed to make a tight seal at manhole walls, the CONTRACTOR shall seal the connection with a resin mixture compatible with the completed lining.

314. LATERAL SEWER CONNECTIONS

- A. Lateral sewers for the purpose of this SPECIFICATION are defined as all house sewers and other service sewers which are connected to the main sewer between manholes. The CONTRACTOR shall connect to the main sewer all active side sewers which are connected to the sewer lines as a part of the CONTRACT. All abandoned service connections shall be plugged and sealed.
- B. After the lining has been cured in place, the CONTRACTOR shall reconnect the existing active service connections as designated by the ENGINEER. This shall generally be done without excavation, and in the case of non-man entry pipes, from the interior of the pipeline by means of a television camera and a cutting device that re-establishes them to not less than 90 percent capacity.

315. FINAL INSPECTION AND TESTING

- A. The watertightness of the lining shall be gauged at the end of the curing period and under a positive head. All visible or detectable leaks shall be repaired by the CONTRACTOR at his expense. Exfiltration shall not exceed 50 gallons per day per inch diameter per mile of sewer for any section of sewer when tested.
- B. After all work is completed, the CONTRACTOR shall have the line inspected by closed circuit television as specified above. All defects shall be repaired by the CONTRACTOR at his expense.

316. DROP MANHOLES

- A. At existing manholes where the incoming sewer invert is twenty-four (24) inches or more above the manhole invert, construct an inside drop structure as shown on the PLANS.

END OF SECTION