

DIVISION IV

SANITARY SEWER REHAB CONSTRUCTION SPECIFICATION

PART 400 – GENERAL PROVISION

400.1 GENERAL

400.1.1 Part 400, general provisions, addresses work required for the adequate completion of the contract, specifically: Contractor's use of premises, sequence of construction, submittals, utilities, and measurement and payment.

400.1.2 Unless otherwise provided for, the order of precedence in case of conflicts or discrepancies between various parts of the contract documents subject to the ruling of the engineer shall generally, but not necessarily, follow the guidelines listed below:

A) Drawings

B) City of Tulsa Standard Construction Specifications

C) Oklahoma Department of Transportation Department Specifications

400.2 CONTRACTOR'S USE OF PREMISES

400.2.1 Confine operations at site to areas permitted by law, ordinances, permits, and the contract documents.

400.2.2 Do not load or permit any part of a structure to be subjected to any force that will endanger its structural integrity or capacity for safe use/operation.

400.2.3 Comply with and enforce City's instructions regarding signs, advertisements, fires, and smoke.

400.2.4 Assume responsibility for protection and safekeeping of products stored on premises.

400.2.5 Do not discharge smoke, dust, or other contaminants into the atmosphere, or fluids or materials into any waterway that will violate regulations of any legally constituted authority.

400.2.6 Move stored products that interfere with the operations of City or other contractors.

400.2.7 Obtain and pay for additional storage or work areas needed for operations.

400.2.8 The steps of the existing manholes cannot be guaranteed for safety; therefore, Contractor shall provide all necessary equipment to assure safe working environment inside the manhole.

400.2.9 The existing facilities will be in continuous operation during the construction period.

- 400.2.10 Plan and conduct construction operations to avoid disturbing existing structures, piping, equipment, and services in any manner that will interrupt or impair operations, except as approved by City's Representative.
- 400.2.11 Submit for approval a construction sequence and written explanation of the temporary facilities and appurtenances intended to be used in maintaining the uninterrupted operation of the existing sanitary sewer system and any other affected utilities.

400.3 SEQUENCE OF CONSTRUCTION

- 400.3.1 Contact property owners 48 hours in advance describing the work to be performed on private property prior to any construction or rehabilitation work on that property. City will provide guidance for notice.
- 400.3.2 Perform excavation work in an orderly manner so that all excavation work is completed in an area before moving to another area unless the engineer or City gives authorization.
- 400.3.3 Ensure that all testing has been completed and reviewed by the engineer prior to final surface restoration.
- 400.3.4 The Contractor shall submit a construction schedule with his first pay request. Revisions to the construction schedule will be submitted with each pay estimate if the Contractor falls more than 10% behind schedule.
- 400.3.5 No reimbursement will be made to Contractor for any water used to perform the work as required in the contract.
- 400.3.6 Notify all local residents who will be denied access to their driveways two working days prior to the closure of their access. Access may be denied only during Contractor's working hours.
- 400.3.7 All driveways that are open cut shall have at least a temporary riding surface provided at the end of each day at no additional cost to City.
- 400.3.8 All cast iron frames and covers from manhole structures that are required to be removed and not reinstalled in accordance with the manhole rehabilitation schedule shown on the drawings will remain the property of the City and shall be delivered to the City yard by the Contractor.
- 400.3.9 No work shall be started on highway Rights-of-Way until the utility permit covering this work has been issued by the Oklahoma Department of Transportation.
- 400.3.10 Keep the work sites free from accumulating waste materials and rubbish caused by Contractor's work or employees. All materials and equipment required on the site shall be kept in such a manner so as to cause a minimum of inconvenience or nuisance to the other contractors and the general public. The site shall be kept broom clean.

- 400.3.11 Where the Contractor's equipment is operated on any portion of a traveled surface or structures used by traffic on or adjacent to the section under construction, clean the traveled surface of all dirt and the debris at the end of each day's operations. The cost to this work shall be included in the applicable unit price bid and no additional compensation will be allowed.
- 400.3.12 Protect traveled surfaces and structures on or adjacent to the work in a manner satisfactory to the engineer from damage by lugs or cleats or equipment. Walking of tracked equipment directly on paved streets, driveways, curbs, or sidewalks shall not be allowed.
- 400.3.13 Equipment used in the performance of the work shall comply with legal loading limits established by the statutes of state and local regulations when moved over or operated on any traveled surface or structure unless permission in writing has been issued by the engineer. Before using any equipment that may exceed the legal loading, the Contractor shall secure a permit, allowing ample time for an analysis of stresses to determine whether or not the proposed loading is within safe limits. The City will not be responsible for any delay in construction operations or for any costs incurred by the Contractor as a result of compliance with the above requirements.

400.4 SUBMITTALS

- 400.4.1 The information provided herein supplements the information provided in the Specification Part 116.
- 400.4.2 For each submittal provided, the Contractor shall:
 - A) Review all shop drawings, project data, and samples before submitting them to the City, and certify that they comply with the contract documents per the information required by the submittal stamp (see paragraph 5 below.)
 - B) Verify field measurements, field construction criteria, catalog numbers, and similar data.
 - C) Coordinate each submittal with the requirements of the contract documents.
 - D) Submit shop drawings for major equipment items in one package to permit checking complete installation details.
 - E) In a clear space above the title block, or on the back, hand stamp the following and enter the required information:

Project Name: _____

Date: _____

Contract Drawing No.: _____

Specification Section: _____

This document has been checked for accuracy of content and for compliance with the contract documents and is hereby approved. The information contained herein has been coordinated with all involved Contractors.

Contractor: _____

Signed: _____

F) Contractor's responsibility for errors, omissions, and deviations from requirements of the contract documents in submittals is not relieved by the City representative's review.

G) Notify City's representative, in writing at time of submittal, of deviations in submittals from requirements of the contract documents.

H) Do not install materials or equipment until approved by the engineer.

400.4.3 Progress schedule: prepare a detailed progress schedule in graphic form showing proposed dates of starting and completing each major division of work, monthly completion percentages, and anticipated monthly payment requests. The schedule shall be consistent with the sequence requirements of the specifications. Submit three copies to the engineer within ten days after notice to proceed. Submit a revised schedule with each pay request.

400.4.4 The Contractor shall submit preconstruction photos, either still or video, of the area within a 20' radius of any work area and shall submit them to the engineer prior to the start of construction in any work area. Photo documentation shall not be performed more than seven days prior to the start of construction at any individual work site.

400.5 TRAFFIC CONTROL

400.5.1 Conduct the work at all times in such a manner as to insure least obstruction to vehicular and pedestrian traffic while paying particular attention to avoid inconvenience in hospital and school zones. Notify engineer at least three workdays in advance of starting any construction work that might inconvenience or endanger traffic.

400.5.2 Submit a traffic control plan to City traffic engineer and appropriate highway official three days prior to closing any road or construction on any nonresidential street. Inform police, fire, and ambulance service companies 24 hours prior to and on the day of closures.

400.5.3 When any section or portion of road is closed to traffic, provide, erect, and maintain barricades, sequencing arrow panels, red flags, detour signs, and lights at each end of the closed section, at all intersecting roads, and at all other locations shown on the

drawings, in accordance with City requirements and the Oklahoma Department of Transportation, as applicable.

- 400.5.4 Replace any traffic signs or posts which have been damaged or removed because of the Contractor's operations.

400.6 UTILITIES

- 400.6.1 Utilities and utility locations shown on the drawings are provided based on utility company atlases, typical placement and location, and other information provided to the engineer. Unless otherwise noted, no excavations or field locates have been performed to determine actual locations and/or elevations of utilities.

- 400.6.2 Notify public and private utility companies which may have overhead or underground facilities in the area at least 48 hours before construction begins. Call Oklahoma One-Call at 1-800-522-6543 for locating utilities. Make necessary arrangements for having these companies locate, protect, brace, or move their facilities as may be necessary for construction of the improvements. Costs incurred due to the moving, bracing, or protection of utilities or in satisfying the requirements of the utility companies will be considered incidental to the cost of the proposed improvement and no separate payment will be made.

- 400.6.3 Proceed with caution with excavation operations so that the exact location of underground utilities and structures, both known and unknown may be determined. Take all reasonable precautions against damage to the utility or structure. However, in the event of a break in an existing utility, immediately notify a responsible official from the organization operating the utility. Lend all possible assistance in restoring service and assume all costs connected with the repair of any damaged utility.

- 400.6.4 It is understood and agreed that the Contractor has considered in his bid all of the permanent and temporary utility appurtenances in the present or relocated positions and that no additional compensation will be allowed for any delays, inconvenience, or damage sustained by him due to any interference from the said utility appurtenances or the operation of moving them either by the utility companies or by him; or on account of any special construction methods required in executing his work due to the existence of said appurtenances either in their present or relocated positions.

400.7 MEASUREMENT AND PAYMENT

- 400.7.1 This section describes the method by which construction of this project shall be measured and paid in accordance with proposal. Only those items with a measurement and payment method described in these general provisions, in the standard construction specification, or the special provisions and included in the proposal shall be measured and paid. Any work shown on the drawings or described in the specifications but not specifically covered by the bid items in the proposal shall be included in other items of work. Any work required in the drawings, standard specifications, or special provisions for which no specific bid items is provided is considered to be ancillary and shall be considered as included in other items of work

and the measurement and payment provisions of the standard specifications shall not apply.

400.7.2 The contract price shall cover all work required by the contract documents. All costs in connections with the proper and successful completion of the work, including furnishing all materials, equipment, supplies, and appurtenances; providing all equipment and tools; and performing all necessary labor and supervision to fully complete the work, shall be included in the unit and lump sum prices bid. All work not specifically set forth as a pay item in the contract documents and on the proposal shall be considered a subsidiary obligation of Contractor and all costs in connected therewith shall be included in the contract prices.

400.7.3 Estimated quantities: quantities stipulated in the proposal or contract documents are approximate and may differ from the quantities indicated on the sanitary sewer pipeline and manhole rehabilitation schedules in the drawings and are to be used on (a) as a basis for estimating the probable cost of the work and (b) for the purpose of comparing the bids submitted for the work. The actual amounts of work done and materials furnished under unit price items may differ from the estimated quantities. The basis of payment for work and materials will be the actual amount of work done and materials furnished. Contractor agrees that he will make no claim for damages, anticipated profits, or otherwise on account of any difference between the amounts of work actually performed and materials actually furnished and the estimated amounts thereof.

400.7.4 Measurements and Payments:

A) Payments will be made in accordance with the general conditions for actual quantities constructed or installed in accordance with the contract documents, be they more or less than the listed quantities; said quantities being measured as specified in the standard specifications or special provisions.

B) Mobilization/demobilization shall be bid as an Each, and THE AMOUNT BID SHALL NOT EXCEED TEN PERCENT (10%) OF THE SUM OF ALL BID ITEM EXTENSIONS EXCLUDING MOBILIZATION/DEMobilIZATION. This item shall include payment for Contractor mobilization and demobilization costs including bonds, insurance, move in and move out of personnel and equipment, project signs and any other costs for mobilization to and demobilization from the site. Mobilization/demobilization shall be paid for on a lump sum basis as follows:

- 1) 50% of the price bid for mobilization/demobilization may be included in the pay estimate which reflects 5% completion of the work.
- 2) An additional 25% of the price bid for mobilization/demobilization may be included in the pay estimate which reflects 50% completion of the work.
- 3) The final 25% of the price bid for mobilization/demobilization may be included on the final pay estimate.

- C) The cost of all required photographic documentation shall be included in the lump sum bid for photo documentation and shall include all labor, equipment, and materials necessary to provide the engineer with the required photo documentation. Payment shall be made commensurate with the total percentage of the work completed.

- D) The cost to protect existing structures, provide all required submittals, comply with the City's "sequence of construction," specifications, all traffic control, and utility protection/relocation are to be included in other items. No additional payment will be made.

PART 401 – SITE PREPARATION

401.1 GENERAL

- 401.1.1 Clear areas necessary for performance of the work and confine operations to that area provided through easements, licenses, agreements, and Rights-of-Way. Entrance upon any lands outside of that area provided by easements, licenses, agreements, or public Rights-of-Way, shall be at the Contractor's sole liability.
- 401.1.2 Do not occupy any portion of the project site prior to the date established in the Notice to Proceed without prior approval of the Engineer.

401.2 MATERIALS: Not specified.

401.3 EXECUTION

- 401.3.1 Remove, relocate, reconstruct, or work around natural obstructions, existing facilities and improvements encountered during site preparation as herein specified. Take care while performing site preparation work adjacent to facilities intended to remain in place. Promptly repair damage to existing facilities. Dispose of waste materials in a satisfactory manner off the work site.

401.3.2 Surface Obstructions

- A) Saw-cut the obstruction in straight lines or remove it to the nearest construction joint if located within 5' of the centerline of the trench. In no case shall the joint or line of cut be less than 1' outside the edge of the trench. Reconstruct surface obstructions removed to permit construction as specified and to the dimensions, lines, and grades of original construction. Restore damaged utilities as required by the utility company at no additional cost to the City.
- B) Protect, move, or brace public and private utilities.
- C) Maintain mailboxes in the manner that the Postal service requires to prevent interruption of mail delivery.

- 401.3.3 Site preparation includes the removal of trees, shrubs, brush, crops, and other vegetation within the limits of the easements (Rights-of-Way), or as may be provided for in licenses, permits and agreements. All efforts shall be made to retain existing landscaping. In the event that trees, shrubbery, and hedges cannot be saved, then prior approval of the Engineer must be obtained before the existing landscaping is removed.

A) Trees

- 1) All trees shall be saved unless removal is approved by the Engineer. Trim trees in accordance with the Engineer's instructions.

B) Shrubbery

- 1) Shrubbery shall be saved unless removal is approved by the Engineer. Make reasonable efforts to save all shrubbery by trimming, in accordance with acceptable pruning practices, and treating wound surfaces with a commercial pruning compound.

C) Small Plants and Flowers

- 1) At least 48 hours prior to the start of construction (one week if manhole is to be replaced or partially replaced), notify property owners of the proposed starting date so that the property owners can remove any small plants or flowers.

401.3.4 Fences interfering with construction, and located within public Rights-of-Way or as may be allowed for in permits or agreements, may be removed only if the opening is provided with a temporary gate which will be maintained in a closed position except to permit passage of equipment and vehicles, unless otherwise herein specified. Fences within temporary construction easements may be removed provided that temporary fencing is installed in such a manner as to serve the purpose of the fencing removed.

- A) Fencing removed shall be restored to the condition existing prior to construction unless otherwise specified. The Contractor is solely liable for the straying of any animals protected or corralled or other damage caused by any fence so removed.

401.3.5 Private Sewer Facilities

- A) Make every reasonable effort to protect private sewer facilities. Private sewer facilities are not shown on the Drawings. When these facilities are disturbed or damaged by the work, make necessary repairs to the facilities to maintain continuous service prior to the close of the workday at no additional cost to the City.

401.3.6 Property Pins

- A) Preserve property corners, pins, and markers. In the event any property corners, pins, or markers are removed by the Contractor, such property points shall be replaced at the Contractor's expense and shall be re-set by competent surveyors properly licensed to do such work. In the event such points are section corners or Federal land corners, they shall be referenced and filed with the appropriate authority.

401.3.7 Sodded and Landscaped Areas

- A) Minimize disturbance to sodded and/or landscaped thoroughfares and areas on or adjacent to improved property. Do not use such areas as storage sites for construction supplies and insofar as practicable, keep free from stockpiles or excavated materials.

401.4 SUBSURFACE OBSTRUCTION

- 401.4.1 Where existing utilities and service lines are encountered, notify the owner thereof at least 48 hours (not including weekends and/or holidays) in advance of performing any work in the vicinity.
- 401.4.2 Excavate, install pipeline, and backfill in the vicinity of such utilities in the manner required by the Engineer and, if requested, under his direct supervision. The Contractor shall be responsible for damages to a public or private utility that may occur as the result of the construction.
- 401.4.3 Protect, move, or brace public and private utilities as specified in Part 400.6 – Utilities.
- 401.4.4 Make a reasonable effort to ascertain the existence of obstructions and locate obstructions by digging in advance of machine excavation where definite information is not available as to their exact location. Where such facilities are unexpectedly encountered and damaged, notify responsible officials and other affected parties and arrange for the prompt repair and restoration of service.
- 401.4.5 MEASUREMENT AND PAYMENT: NO CONTRACT PRICES ARE ESTABLISHED FOR SITE PREPARATION.

PART 402 – RESTORATION

402.1 GENERAL

402.1.1 Restore the project site to conditions not less than that existing prior to starting construction unless otherwise required by these specifications, Permits and/or Licenses, or shown on the Drawings.

402.1.2 Coordinate surface restoration work with the affected private property owners and the Engineer.

402.1.3 Private property over which the City has prior rights (i.e. utility easement, sewer easement) and/or has obtained Rights-of-Way, agreements, licenses and/or agreements from the property owner to allow construction of a sanitary sewer pipeline and appurtenances, shall be restored in conformance with these Contract Documents.

402.1.4 Restore Public property with strict adherence to the requirements of the public body having jurisdiction therein.

A) No restoration shall occur until testing is complete and accepted by the Engineer.

B) Complete final surface restoration within three weeks of the repair or as directed by the Engineer.

402.1.5 Reference Standards

A) Surface restoration including but not limited to pavement, driveways, sidewalks, curb and gutters, and sodding shall be in accordance with contract documents and the current edition of City of Tulsa Standard Specifications.

402.2 MATERIALS

402.2.1 Topsoil

A) Topsoil shall be free from large roots, sticks, weeds, brush, stones or other litter and waste products. A minimum of 4" compacted depth of topsoil shall be used.

B) The soil texture shall be classified as loam or sandy loam according to the following criteria:

Loam	Sand Loam
Sand (2.0 to 0.05 mm diameter) (No. 10 sieve)	25-50% 45-85%
Silt (0.05 to 0.002 mm diameter) (No. 270 sieve)	30-50% Less than 50%
Clay (smaller than 0.002 mm diameter) (Hydrometer analysis)	5-25% Less than 20%

C) Soil texture shall be determined by utilizing processes as prescribed in ASTM D422 using the No. 20 and No. 270 sieves and a hydrometer analysis.

402.2.2 Fertilizer

A) Fertilizer shall be a standard commercial 16-8-8, uniform in composition, free flowing and suitable for application with approved equipment, delivered to the site in bags or other convenient containers each fully labeled, conforming to applicable State laws.

402.2.3 Sod

A) Sod shall be approved nursery or field grown grass that is native to the locality of the work and shall match existing in the area of excavation. Sod shall be well rooted in soil of such consistency that it will not break, crumble, or tear during handling and placing. Sod shall be free of noxious weeds and other objectionable plants and shall not contain substances injurious to growth.

B) Grass shall be between 1-1/2" and 4" in length when the sod is cut. The sod shall be cut within 48 hours of placement in rectangular pieces not less than 12" in width and not less than 1" in soil thickness. Keep sod in a moist condition between the initiation of cutting and the completing of placing and protect against exposure to the sun, wind, freezing during transportation to the site, and during storage prior to placing.

402.2.4 Portland Cement Concrete

A) Portland Cement concrete shall have minimum compression strength of 5000 psi at 28 days and meet the requirements of Part 329 of the City of Tulsa Construction Specifications.

402.2.5 Curing Compound Commercial grade conforming to ASTM C309, Type I.

402.2.6 Reinforcing Steel: Conform to ASTM A615, Grade 40.

402.2.7 Asphalt Cement, Prime Coat and Tack Coat.

402.2.8 Asphalt Concrete

A) Asphalt for paving shall be Type B top lift and Type A base lift as per Oklahoma Department of Transportation Section 708, and Part 329 of the City of Tulsa Standard Specifications.

402.2.9 Gravel Resurfacing

402.2.10 Wearing surface on gravel surfaced streets or drives shall be replaced with 9" of compacted gravel backfill with a minimum P.I. of 4. The material shall be required to

meet the sieve test of the current ASTM E11 for conformity to ASTM D448 for a Standard Aggregate Size Number 67 and a percent of wear test not to exceed 35 when tested in accordance with ASTM C131.

402.3 EXECUTION

402.4 CLEANUP

402.4.1 Upon completion of installation and backfill operations, clean and dress up the work area as follows.

- A) Remove construction debris and litter from the site.
- B) Remove excess excavation material from the site including material that has washed into streambeds, storm water facilities, streets, culverts, etc.
- C) Remove tools, equipment, and construction materials except for designated storage areas along the pipeline route. Maintain designated storage areas in a neat appearing manner.
- D) Restore surface and subsurface drainage and provide drainage wash checks necessary to prevent soils from being washed downstream.
- E) Machine-grade the area in preparation of final grading, seeding, sodding, pavement replacement, etc.
- F) Restore all street signs and mailboxes.
- G) Maintain adequate safety signs, barricades, and lights until final restoration of work area is completed.

402.4.2 Finish Grading

- A) Finish grade the area to lines and grades which existed prior to the area being disturbed, with special attention directed to proper surface drainage, and the refilling of settled excavations with earth compacted to densities required. The area shall be smoothed by raking or dragging. Flower and vegetable gardens in existence prior to this project shall have the separately stored topsoil restored unless otherwise required. Areas to be sodded or seeded shall have a minimum 4" depth of topsoil.

402.4.3 Sod

- A) Restore grassed areas disturbed by construction with sod to match existing. Sod may be placed between the average date of the last freeze in the Spring and six weeks prior to the average date for the first freeze in the Fall according to the Almanac or U.S. Weather Bureau for the area unless otherwise approved by the Engineer in writing. Place sod at any time during this period except when the

temperature is over 90° Fahrenheit, drought conditions exist, or the sod or ground surface is frozen. Cut sod as thick as possible to aid the sod in taking root at the earliest possible date.

- B) Spread fertilizer nutrients over the area at a rate of 160 pounds per acre (nutrient weight only) or as recommended by the manufacturer.
- C) Place sod on the prepared surface with the edges in close contact and the alternate courses staggered. Bury exposed edges of the sod flush with the adjacent soil. In ditches, Place sod with the longer dimension perpendicular to the flow of the water in the ditch. On slopes, starting at the bottom of the slope, place sod with the longer dimension perpendicular to the slope of the ground and where the slope is 2:1 or greater, stake the sod. Sod shall be rolled after placement and joints filled between sections with scarified soil. Within eight hours after placing the sod, apply five gallons of water per square yard.
- D) Provide sufficient water to prevent the sod from drying out.
- E) Existing sod, which was salvaged during construction, may be reused at the Contractor's option.
- F) Sod shall have taken root before acceptance Contractor shall guarantee sodding one year after acceptance by the City.

402.4.4 Tree, Bush, and Hedge Transplanting and Replacement

- A) Existing trees, bushes, and hedges which cannot be tied back or trimmed to prevent damage and require removal because of the proposed construction shall be transplanted with a tree spade or replaced. Tree removal shall include removal of stump and roots 4" below grade. Transplanting shall be at the location directed by the Engineer. After digging the plants, properly store them until they can be transplanted. Replacement plants shall not be delivered until they can be planted.
- B) Plant during the proper seasons. Do not plant in frozen soil or during unfavorable weather conditions. Dig tree pits of such size as to provide ample space for the entire root system, as the tree comes from the nursery, without crowding or bending the roots. The pits shall be 12" wider than the ball diameter, have vertical sides, and be 6" deeper than the thickness of the ball. Thoroughly loosen the soil in the bottom of the pit by spading to a depth of 6". Dig holes immediately before planting. Dispose of soil earth dug from the tree pits.
- C) Set trees at a depth slightly above finished grade, half-fill the hole with planting soil and thoroughly water. Loosen and fold down the upper half of the burlap, fill the hole with planting soil and thoroughly water. Fill the top 2" with well-rotted mulch.
- D) After planting, prune the branches in proportion to the amount of root system lost in the transplanting operations but in such a manner as to retain the form typical of the tree. In general, remove approximately 1/3 of the branch structure. Pruning

shall be done by expert workmen in such a manner as to insure healthy and symmetrical growth of new wood.

- E) After planting, wrap trunks of trees planted after October 15 with special tree wrap from the crotch of the first major branches down to the ground. Tie wrapping with cotton twine to keep the wrapping in place.
- F) Plant trees vertically. Trees found leaning during the guarantee period shall immediately be staked with two 2" x 3" wood stakes, 8' long, pointed on one end. The stake shall be long enough to properly support the tree. Drive the stakes to a depth of 18" below the bottom of the tree pit. Locate the stakes on the north side and the south side of the tree, and 12" to 18" from the trunk. Do not drive stakes into the ball and burlap. Guy the trees using a figure eight hitch consisting of No. 14 gauge wire encased in a section of rubber hose.

402.4.5 Restoration of Pavement Surfaces

- A) Restore (unless otherwise specified or ordered by the Engineer) permanent type pavements, sidewalks, driveways, curbs, gutters, and surface structures removed or disturbed during or as a result of construction operations to a condition which is equal in appearance and quality to the condition that existed before the work began. The surface of all improvements shall match the appearance of the existing surface.
- B) Pour concrete only after inspection by the Engineer of the pouring site to verify proper forms and reinforcement. Reinforcement shall be equal in quantity and type of materials to reinforcement that existed prior to the work, or as indicated in the plans or specifications.
- C) Saw-cut existing paved surfaces to provide a straight joint between the existing and new surface. Saw cutting shall be full depth and square or rectangular in shape.
- D) Cure and protect all exposed concrete installed under this contract in accordance with the reference standard.
- E) Allow concrete to attain a minimum seven-day strength before allowing traffic or construction equipment on the concrete.
- F) Remove entire sidewalk squares. Removal of partial squares shall not be allowed.

402.5 CONCRETE SIDEWALKS

- 402.5.1 Concrete sidewalks shall consist of a minimum thickness of 4" of non-reinforced Portland cement concrete over 4" of compacted granular material.
- 402.5.2 Increase sidewalk thickness to 6" when crossing residential driveways.
- 402.5.3 Place 1/2" preformed bituminous expansion joints at junctions with existing work and at intervals not exceeding 50', or as directed by the Engineer.

- 402.5.4 Saw-cut existing sidewalks at construction joints. Patching existing sidewalk squares damaged during construction activities shall not be allowed.
- 402.5.5 When removing portions of a concrete sidewalk, an entire square shall be removed. Removal of a partial sidewalk square shall not be allowed.
- 402.5.6 At locations where sidewalks intersect with streets and sidewalk restoration is required, Contractor shall construct wheelchair ramps in accordance with the detail shown in Standards.

402.6 CONCRETE CURB AND GUTTER

- 402.6.1 Curb and Gutter dimensions and cross sections shall conform with existing installations.
- 402.6.2 Place two dowels at each junction with existing work. Dowels shall be 3/4" diameter and a minimum of 12" in length.
- 402.6.3 Place 1/2" preformed bituminous expansion joints at junctions with existing work and at intervals not exceeding 50', or as directed by the Engineer.
- 402.6.4 Place doweled expansion joints at intervals not exceeding 50', or as directed by the Engineer.
- 402.6.5 Saw-cut control joints at intervals not exceeding 20' and at junctions with existing traverse cracks in the pavement, or as directed by the Engineer.

402.7 CONCRETE DRIVEWAYS

- 402.7.1 Replace concrete driveways to the condition and thickness that existed prior to construction. Minimum thickness shall be 6".

402.8 BITUMINOUS CONCRETE DRIVEWAY

- 402.8.1 Replace bituminous driveways to the condition and thickness that existed prior to construction. Minimum thickness shall be 2". Construction shall be executed in accordance with Asphalt Concrete Pavement Replacement for Pipe Trenches.

402.9 TACK COAT

- 402.9.1 Apply a tack coat on existing asphalt concrete pavement and to each lift of new pavement that is to receive a succeeding lift in conformance with applicable requirements of Oklahoma Department of Transportation (ODOT) Section 708.

402.10 PRIME COAT

402.10.1 The prime coat shall be applied to the leveling course in accordance with applicable requirements of Oklahoma Department of Transportation Section 708 at the rate of 0.20 to 0.30-gallon per square yard of surface area. The exact amount is to be determined by the Engineer.

402.11 CONSTRUCTION OF ASPHALT CONCRETE PAVEMENT

A) Lay asphalt concrete over the base course in a single lift and the compacted depth shall be 3". The method of proportioning, mixing, transporting, laying, processing, rolling the material, and the standards of workmanship shall conform to the applicable requirements of ODOT Section 708 of the Standard Specifications.

B) The Engineer will examine the base before the paving is begun and bring any deficiencies to the Contractor's attention to be corrected before the paving is started. Roll each lift of the asphalt concrete and compact to the density specified in the referenced Standard Specification for Highway Construction. The grade, line, and cross section of the finished surface shall conform to the Drawings. Asphalt or asphalt stains which are noticeable upon surfaces of concrete or materials, which will be exposed to view, shall be promptly and completely removed.

402.12 ASPHALT HIGHWAY REPAIR

402.12.1 Asphalt Highway Repair shall be in accordance with the Oklahoma Department of Transportation Standard Specifications for Highway Construction.

402.13 CONCRETE HIGHWAY REPAIR

402.13.1 Concrete Highway repair shall be in accordance with the Oklahoma Department of Transportation Standard Specifications for Highway Construction.

402.14 WEATHER CONDITIONS

402.14.1 Asphalt shall not be applied to wet material. Asphalt shall not be applied during rainfall, sand or dust storm, or any imminent storms that might adversely affect the construction. The Engineer will determine when surfaces and material are dry enough to proceed with construction. Asphalt concrete shall not be placed: 1) when the atmospheric temperature is lower than 40° F, 2) during heavy rainfall, or 3) when the surface upon which it is to be placed is frozen or wet. Asphalt for prime coat shall not be applied when the surface temperature is less than 50° F. Exceptions will be permitted only in special cases and only with prior written approval of the Engineer.

402.15 CONCRETE PAVEMENT

402.15.1 Pavement replacement shall be as shown on the typical section for Manhole restoration. Protect the newly placed concrete from traffic for a period of seven days and cure by covering with burlap, sand, earth, or sawdust, which is kept continuously wet.

402.15.2 Handle and place concrete pavement in accordance with the Standard Specifications for Highway Construction of the Oklahoma Department of Transportation.

402.16 FENCE REMOVAL AND REPLACEMENT

402.16.1 Restore or replace existing fences that were removed or disturbed during or as a result of construction operations, to a condition equal in appearance and quality to the condition that existed before the work began.

402.17 MEASUREMENT AND PAYMENT

402.17.1 Sidewalk and Driveway Removal and replacement, Pavement Removal and Replacement, Gravel Resurfacing, Replacement of Curb and Gutter, Fence Removal and Replacement, and Sodding, are considered to be Restoration work items. Payment for Restoration work items will be as follows:

402.17.2 Payment for Sidewalk and Driveway Removal and Replacement, and Pavement Removal and Replacement shall be made at the unit price bid, per square yard replaced, as measured along the centerline of the sanitary sewer pipe being replaced. Sodding will be made at unit bid prices bid, per square yard, as measured along the centerline of the line being replaced. Payment will be made for open cut pipeline replacement only (except for open cut point repairs, where all surface restoration is subsidiary).

402.17.3 Gravel Resurfacing Payment shall be made at the unit price bid per linear foot, in accordance with City of Tulsa Standards, as measured along the centerline of the sanitary sewer pipe being replaced. Payment will be made for open cut pipeline replacement only (except for open cut point repairs, where all surface restoration is subsidiary).

402.17.4 Replacement of Curb and Gutter Payment shall be made at the unit price bid per linear foot of Curb and Gutter actually removed and replaced.

402.17.5 All other restoration work items discussed in this section are considered subsidiary and shall not be paid for directly.

PART 403 – BACKFILL

403.1 GENERAL

- 403.1.1 This section governs all labor, equipment, materials, and testing required to properly backfill trenches and excavations around manholes and structures.
- 403.1.2 No granular embedment or other backfill material shall be used by the Contractor without approval by the Engineer.

403.2 MATERIALS

- 403.2.1 Trench Foundations Materials: 3" minus river-run or pit-run gravel, free from clay balls, roots, and organic matter; well crushed gravel or crushed rock graded with less than 8% by weight passing the 1/4" sieve. Submit samples for approval prior to delivery of the material to the site. Trench foundation material shall only be used where unsuitable soil conditions are encountered under sewers before the depth of standard embedment is reached.
- 403.2.2 Embedment: Embedment material shall be sand or crushed stone as required by Bedding Detail Standards No. 18 or No. 19, as applicable.
- 403.2.3 Trench Backfill: Trench backfill will be divided into the general classification as follows:
 - A) Street Backfill: Street backfill material above the pipe embedment material shall be ODOT Type A aggregate base compacted to 95% Standard Proctor density per AASHTO T 99.
 - B) Trench Backfill: Backfill for trenches in unpaved areas shall meet the following requirements: Excavated material free from roots, organic matter, trash, debris, rocks larger than 12", and other deleterious materials. Suitable material may be obtained by the Contractor from the excavation for the proposed pipelines. Provide imported material of equivalent quality, or sand, if required to accomplish the work.

403.3 DESCRIPTION

- 403.3.1 The Contractor shall be responsible for the furnishing of all labor, supervision, materials, equipment, and testing for the completion of backfill operations in accordance with the Contract Documents.
 - A) Unless otherwise specified, all sewer trenches and excavation around structures shall be backfilled to the original surface of the ground.
 - B) The Contractor shall be responsible for all damage or damages which might occur as a result of the settlement of trench or other backfill made by him in the fulfillment of these Contract Documents, within and during a period of one year from and after the date of final acceptance thereof by the City, including the cost to the City of all claims of damages filed with and court actions brought against the said City for and

because of such damage, and the repair to the satisfaction of the Engineer of any and each pavement, driveway, curb, slab, walk, or structure damages by such backfill settlement.

403.4 EXECUTION

- 403.4.1 Remove trash and debris from the excavation prior to backfilling.
- 403.4.2 Backfilling trenches and excavations to the original ground surface unless otherwise indicated on the Drawings.
- 403.4.3 Carefully place backfill materials to avoid damage to or displacement of the pipeline and other exposed utilities or structure.
- 403.4.4 Do not backfill with frozen material or when a blanket of snow prevents proper compaction. Backfill shall not contain waste material, trees, organic material, rubbish, or other deleterious substances.
- 403.4.5 The backfill material shall be placed in lifts. Each lift shall be compacted to the required density prior to the next lift being placed.
- 403.4.6 In gardens or flower gardens, the original topsoil shall be replaced to original elevation, location, and depth. Minimum depth shall be 12”.

403.5 BACKFILLING STREET RIGHTS-OF-WAY AND PAVEMENT AREAS

- 403.5.1 Backfill trenches under and within 2’ of all existing and proposed pavement, driveway pavement, sidewalk, and curb and gutter using ODOT Type A aggregate base.
- 403.5.2 Compaction Method
 - A) Granular trench backfill shall be mechanically compacted in layers of 8” loose measure. Each layer shall be firmly compacted to 95% of Standard Proctor density as determined by ASSHTO T99. Material may be compacted by tamping or by using surface vibrators in such a manner as not to disturb or injure the pipe. At least 72” of cover over sewer pipe shall be provided before using mobile trench compactors of the hydrohammer or impactor type.
- 403.5.3 Undermining of Paved Surfaces: Where undermining of paved surfaces has occurred, Contractor shall remove the paved surface above the undermined area prior to placing backfill.

403.6 BACKFILLING IN AREAS OTHER THAN STREET RIGHTS-OF-WAY AND PAVEMENT AREAS

- 403.6.1 Backfill trenches using acceptable job excavated materials or as directed by the Engineer.

403.6.2 Backfill in layers of 18" maximum and mechanically compact to 95% of maximum density as defined by AASHTO T 99 (Modified Proctor test).

403.6.3 Place a minimum of 18" of granular backfill above the top of pipe in areas where the existing surface elevation is less than 24" above the proposed top of pipe. The granular backfill shall extend 1' from each side of the pipe and shall be placed at a 1:1 slope to bedding material or the existing ground surface.

403.7 CLAY DAMS

403.7.1 Clay dams shall be installed where shown on the plans. The dams shall be constructed in such a manner that an impervious barrier is constructed to prevent ground water from following the pipeline trench past the new construction.

403.7.2 The work will be constructed in accordance with details in these specifications.

403.8 TESTING

403.8.1 All density tests shall be performed per AASHTO standards by the City of Tulsa.

403.8.2 Tests shall be performed to meet the required density.

403.8.3 The cost of providing access to the level of trench backfill to be tested will be a cost to the Contractor, and no extra compensation will be allowed for exposing of the backfill layer to be tested.

403.8.4 Tests which indicate compaction results non-conforming to specified densities shall be re-compacted to proper density by the Contractor at no additional cost to City.

403.9 RESPONSIBILITY OF CONTRACTOR FOR BACKFILL SETTLEMENT

403.9.1 Wherever trenches or other excavations made by the Contractor in the performance of work under these Contract Documents have not been properly filled, or where settlement has occurred at any time prior to the expiration of the one year correction period, to the extent that the top of the backfill is below the original ground surface, such trenches shall be refilled and the backfilled surface compacted and smoothed to conform to the elevation of the adjacent ground surface. All sod in lawns or pavement damaged by reasons of such settlement, and the repair thereof, shall be replaced at no additional cost to City.

403.10 MEASUREMENT AND PAYMENT

403.10.1 Payment for the work in this section is considered subsidiary to other items of work and will not be paid for directly.

PART 404 – REMOVAL, SALVAGE, AND ABANDONMENT OF EXISTING FACILITIES

See Part 333 in Division III – Construction Specifications for requirements.

PART 405 – PIPELINE AND INSTALLATION

405.1 GENERAL

- 405.1.1 INTENT: The work under this item shall include furnishing, hauling, placing, and jointing of cast iron, ductile iron, vitrified clay pipe and PVC pipe in the trench in specific conformity with the lines and levels given.
- 405.1.2 RELATED WORK: Testing, and other general requirements for construction of pipe utilities are included in other sections of the Specifications.

405.2 QUALITY CONTROL

- 405.2.1 The Engineer shall have the right to reject pipe based upon visual defects including out-of-roundness, rough interior, discoloration, warping, or other visual defects which, in the opinion of the Engineer, affect the function or life of the pipe.

405.3 MATERIALS – DUCTILE IRON PIPE

- 405.3.1 Materials shall conform to Part 203 – Ductile Iron Pipe, Ductile and Cast-Iron Fittings, and Valves.
- 405.3.2 Sleeve couplings shall be Dresser Style 38 or equal, 7" x 3/8" designed for the specified pipe pressure class and shall have middle rings equal in thickness to that of the adjoining pipe. Couplings shall have plain gaskets, Grade 27. All fittings, bolts and related components shall be epoxy coated. Unless noted otherwise, joint harnesses shall be provided at sleeve couplings.

405.4 COATING, LINING, AND POLYETHYLENE WRAP

- 405.4.1 Cast iron and ductile iron pipe and fittings 12" I.D. and smaller shall be bituminous coated outside in accordance with AWWA C151, and cement-mortar lined inside with seal coat in accordance with American Standard for Cement Mortar Lining for Cast Iron Pipe and Fittings for Water, AWWA Designation C104. See section 203.1.6 for coatings associated with sanitary sewer lines 15" I.D. and larger.
- 405.4.2 Polyethylene tube shall be furnished with all DIP pipe and fittings per section 202.3 of City of Tulsa Standard Specifications. Polyethylene tube shall be in accordance with AWWA C105. It shall be made from virgin polyethylene resin in accordance with ASTM Specification 31248. Thickness shall not be less than 8 mils (.008"). The material shall be chemically inert and moisture resistant to form an effective seal against penetration by water or vapor. Tensile strength shall be 1800 psi with elongation of 500%. The material shall be Polyetube, or equal, as manufactured by Polyetube Corporation, Birmingham, Alabama. Tape of polyethylene tube shall be plastic-backed adhesive tape, Polykan #900 or Scotchrap #50 or equal, 2" in width. The tube shall be of such length that a 1' overlap is provided at each joint in pipe.

405.5 MATERIALS – PVC PIPE

405.5.1 Material shall conform to Part 208 – Polyvinyl Chloride (PVC) Pipe, Sewer Service.

405.6 EXECUTION – DUCTILE IRON PIPE

405.6.1 INSTALLATION: Installation method shall conform to Part 307.1 of the City of Tulsa Construction Specifications.

405.6.2 PRESSURE PIPELINES

A) All fittings or specials included as pipe shall be blocked in accordance with the Standard Details.

405.6.3 If a joint is to be deflected, it shall be made up in a straight line before deflecting and shall be in accordance with the manufacturer's recommendations.

405.7 GRAVITY PIPELINES

405.7.1 Joints between ductile iron pipe and other types of pipe shall be made with an AWWA C110 long body solid sleeve or another adapter as approved by the Engineer. If adapters are not available, the joint shall be made as instructed by the Engineer and encased with concrete 1' each side of the joint.

405.7.2 The pipe shall be laid on a firm trench bottom, true to the lines and grades shown on the Plans and/or as given by the Engineer. The laying of the pipe in finished trenches shall be commenced at the lowest point, with the plain end pointing in the direction of flow. The ends of adjoining pipes shall butt against each other for their entire circumference so there is no shoulder or unevenness of any kind.

405.7.3 Pipe grade shall be obtained using laser beam, other electronic equipment, or batter boards and a "top line." The equipment and proposed method of use shall be approved by the Engineer.

405.7.4 Clean joint contact surfaces immediately prior to jointing. Use lubricants and other materials recommended by the pipe manufacturer.

405.7.5 Backfill trenches immediately after pipe is laid in accordance with Part 403 BACKFILL and Part 402 RESTORATION.

405.8 EXECUTION – PVC SEWER PIPE

405.8.1 PVC sewer pipe shall be installed in accordance with the Standard Details and with ASTM D2321, Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe, latest edition.

405.8.2 Thirty days minimum after backfill is in place, PVC sewer pipe shall be measured for vertical ring deflection using a deflection testing mandrel in accordance with the Standard Details. The deflection testing shall be done by the Contractor in the

presence of the Engineer or his designated representative. Maximum ring deflection of the installed pipe shall be limited to 5% of the average inside diameter as defined by ASTM Designation D2680. All pipe exceeding the allowable deflection shall be replaced by the Contractor at no additional cost to the Owner. Equipment used in making the measurements shall be subject to the approval of the Engineer. The Contractor will furnish the appropriate mandrel for the deflection test. Mechanical devices to pull the mandrel through the pipe will not be allowed.

405.8.3 Manhole water stop gasket and clamps assembly shall be constructed at each point where PVC sewer pipe enters/exits manhole. Fluted gasket shall be placed around pipe secured with stainless steel retainer ring. Standard o-ring coupling shall be placed around manhole water stop assembly. Engineer shall approve water stop assembly.

405.8.4 Sewer Service Laterals and Connections

A) Service shall be located and exposed before replacement operations.

B) All service laterals attached to the existing sewer shall be completely disconnected and isolated from the existing sewer before the replacement operation. (Note: Failure to do this may result in damage to laterals.)

C) Service laterals shall not be reconnected to new sewer line until installation and testing are completed. Contractor is responsible to verify each service connection to determine whether it is active or inactive. All service connections to existing buildings are to be reconnected, except where disconnection is approved by the Engineer. Service connection to a vacated lot shall not be reconnected. If more than one service is found per lot, then the Contractor shall verify that service connections are active by introducing dye into the lines at cleanouts, vents stacks or other access points as approved by the Engineer. Dye testing shall be recorded by CCTV inspection at the location in the main line where the dye appears. All addresses will be noted on log sheets for future references. Provide the address of all reconnected and disconnected services.

D) Reconnection factory tees and materials shall be as approved by the Engineer for the type of new pipe installed and lateral pipe.

405.9 MANHOLES

A) Sewer pipe entrances and exits to manholes shall be opened out to appropriate dimensions and may require that modifications be made to invert before the replacement operation if the tool and new pipe is planned to traverse the manhole without interruption during the operation.

405.10 SURFACE RESTORATION

405.10.1 Service and lateral pits, and other work areas shall be restored to condition as good as that before construction occurred. Disturbed grassed areas shall be sodded in

accordance with Part 402 – RESTORATION. Pavements removed or damaged shall be replaced at Contractor's expense in accordance with these specifications.

405.11 TESTING

405.12 MEASUREMENT AND PAYMENT

405.12.1 PIPE: Payment shall be made at the unit price bid per linear foot of pipe of the size and type specified in the Bid Schedule and placed as shown on the Drawings. Total footage shall be the actual measurement along the centerline of the pipe, measured to the nearest 0.1', center of manhole to center of manhole, less 1/2 the diameter of both the upstream and downstream manholes. No additional payment shall be made for vertical pipe or fittings used with drop manholes, or fittings or specials included as pipe for concrete blocking.

405.12.2 The prices shall be payment in full for performing and completing the work and for furnishing all labor and materials necessary including excavation and removal of existing structure, pipe materials, pipe sealing materials, trench safety system, backfilling, all testing, bypass pumping and all incidental costs.

PART 406 – PIPE REAMING

406.1 GENERAL

- 406.1.1 This section governs all work, materials, and testing for installation of pipe by the trenchless method of reaming existing pipes as shown on the Drawings and in conformity with these specifications. The operation shall be conducted with a directional drilling machine and a reamer that grinds and pulverizes the pipe, the excess peripheral material flushed and removed with the drilling fluids and the replacement pipe of the required size pulled into place simultaneously.
- 406.1.2 Description: Pipe installation shall consist of furnishing all labor, materials, and equipment for the complete installation of pipe in accordance with Contract Drawings, General Conditions, and these specifications.
- 406.1.3 Specification modifications: It is understood that throughout this section Specifications may be modified in accordance with the appropriate section(s) of the Contract Documents.
- 406.1.4 Revisions of Standards: When reference is made to a Standard Specification, i.e., ASTM, ANSI, AWWA, the Specification referred to shall be understood to mean the latest revision of said specification as amended at the time of the Notice to Bidders, except as noted on the Drawings, or in the Contract Documents.
- 406.1.5 Submittals: The Contractor shall provide certifications, shop drawings, or samples on all materials provided under these specifications.
- 406.1.6 Experience: The Contractor shall have experience installing line using the pipe reaming system, with a minimum of 10,000' in installations, demonstrate proof of instruction by the licensor of such system, or provide on-site advisory services of the licensor until such time that the contractor's competency to perform this work is acceptable to the owner's representative.
- 406.1.7 Pipe Reaming Preparation. The following preparation work shall be performed by CONTRACTOR unless otherwise approved by Engineer.
- A) Safety. CONTRACTOR shall carry out his operation in accordance with OSHA standards and recommended safety standards of the manufacturer. Particular attention is directed to safety standards and practices applicable to work performed involving scaffolding and confined spaces.
 - B) Bypassing Sewage. CONTRACTOR, when required, shall provide for the flow of sewage around the section or sections of pipe that are to be rehabilitated. The bypass shall be made by plugging the line at an existing upstream manhole and pumping the flow into a downstream manhole or adjacent system. The pump and bypass lines shall be of adequate capacity and size to handle anticipated wet weather flow.

C) Interruption of Service. When preparing to make a connection to the existing system or other work, which will interrupt service to the utility users, CONTRACTOR shall notify the affected user at least 48 hours in advance of service interruption, stating the approximate time and duration of interruption of service. Advance notification shall not extend beyond 72 hours. CONTRACTOR shall coordinate with the authorities having jurisdiction, any necessary interruption of service and shall limit such interruption to the duration mutually agreeable to both parties.

406.1.8 Manhole Replacement. In those places where the insertion pit shaft is excavated at an existing manhole, the manhole shall be replaced with a new manhole conforming to Part 416, Complete Manhole Replacement and in accordance with the Details. Where manhole replacement is specified at locations not scheduled to be an insertion pit, The CONTRACTOR may, at the discretion of the ENGINEER, do a complete rehabilitation of the manhole in accordance with Parts 416 through 421. Costs for such work are incidental to the project and shall be the responsibility of CONTRACTOR.

406.1.9 Sealing Pipe in Manhole. The annular space between the replacement pipe and the existing sewer line shall be sealed where the sewer line enters or exits each manhole. This annular space shall be sealed for a distance of 12" to 18" inside the old sewer line with a non-shrink grout. The method of sealing shall be approved by ENGINEER.

A) Sealant should not protrude into the manhole more than 1" and shall be finished over with a quick-set, non-shrink type of cement grout. Finishing inside the manhole shall be accomplished using a quick-set cement type grout to raise the manhole trough to the invert of the replacement pipe, as required.

406.2 REFERENCE SPECIFICATIONS

406.2.1 This Specification references American Society of Testing Materials (ASTM) Standard Specifications, which are made a part hereof by such reference and shall be the latest edition and revision thereof.

406.3 MATERIALS

406.3.1 This Section governs materials required to complete pipe installation by the pipe reaming method as shown on the Drawings and/or provided for in the Contract Documents.

406.3.2 Pipe and Fittings

A) Polyvinyl Chloride (PVC) Pipe

- 1) PVC pipe shall be a restrained joint type such as Certa-Lok™ or Yelomine™ manufactured by CertainTeed Corporation and conform to the requirements of ASTM D2241, "Standard Specification for Polyvinyl Chloride (PVC) C-900, and manufactured from Type 1, Grade 1, 2000 psi hydrostatic design stress Polyvinyl Chloride compound and materials in accordance with ASTM D1784 Class 12454-B, or other restrained joint PVC pipe meeting these specifications

and capable of withstanding the stresses imposed on the pipe during installation.

- 2) Joints shall meet the requirements of ASTM D3139, "Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals."
- 3) O-rings shall meet the requirements of ASTM F477, "Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe."
- 4) The minimum wall thickness shall not be less than DR 14.

406.4 MATERIAL TESTS

- 406.4.1 test for compliance with this Specification shall be made according to the applicable ASTM Specification. A certificate of compliance with this Specification upon request shall be provided by CONTRACTOR for all material furnished under this Specification. In addition, CONTRACTOR may, at his own expense, witness inspection and test of the compliance with this Specification upon request shall be provided by the manufacturer for all material furnished under this Specification.

406.5 REJECTION

- 406.5.1 Any material may be rejected for failure to meet any of the requirements of this Specification.

406.6 SERVICE CONNECTIONS

- 406.6.1 After the replacement pipe has been secured, service connections shall be excavated and reconnected to the new pipe. All service connections to existing buildings are to be reconnected, except where disconnection is approved by the Engineer. Service connection to a vacated lot shall not be reconnected. If more than one service is found per lot, then the Contractor shall verify that service connections are active by introducing dye into the lines at cleanouts, vents stacks, or other access points as approved by the Engineer. Dye testing shall be recorded by CCTV inspection at the location in the main line where the dye appears. All addresses will be noted on log sheets for future references. Provide the address of all reconnected and disconnected services. The replacement pipe shall be exposed to provide adequate working space for making the new service connection. Service laterals shall be connected to the liner pipe using approved saddle connections, INSERTATEE, or equal. Service interruptions to any homes tributary to the sewer line being rehabilitated shall not exceed 36 hours. Care shall be used not to damage the pipe. If damage occurs as a result of the Contractor's operations, the CONTRACTOR shall assume all cost associated with the repair of the pipe.

406.7 BACKFILL

- 406.7.1 At all points where the reamed pipe has been exposed (such as at the insertion pit or at service connection fittings), the pipe and fittings shall be backfilled and compacted

to required finished grade in accordance with Part 302 EXCAVATION AND BACKFILL, Part 402 RESTORATION, and Part 403 BACKFILL.

406.8 FINAL ACCEPTANCE

406.8.1 After installation of the replacement pipe, CONTRACTOR shall TV inspect the sewer line as specified and perform the following test on the sewer line. Deformation of the replacement pipe of 6% or more, as determined by a standard mandrel test following construction, shall be reason for rejection of the installation.

406.8.2 Testing. After installation and before any service connections are reinstated, CONTRACTOR shall run a test on the sewer line to determine if it is watertight.

406.8.3 CONTRACTOR shall furnish all necessary equipment to conduct the test. An acceptable method is a low-pressure air test, conducted as follows:

A) Pressurize the test section to 4.0 psi and hold above 3.5 psi for not less than two minutes. Add air if necessary, to keep the pressure above 3.5 psi. At the end of this two-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.

Carrier Pipe Diameter (inches)	Minimum Elapsed Time (minutes)
8	4
10	5
12	6

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

C) 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.

D) If building service connections have been reinstated before the air test, they shall be considered part of the pipe to which they are connected, and no adjustment of test time shall be allowed.

E) The pressure gauge used shall be supplied by CONTRACTOR and have minimum divisions of 0.10 psi and shall have an accuracy of 0.004 psi.

F) Payment for air pressure tests, including the furnishings and installing of all equipment and materials, conducting the pressure test, and making all necessary repairs shall be considered as incidental to the Contract amount.

406.9 CLEANUP

406.9.1 After the installation work has been completed and all testing acceptable, CONTRACTOR shall clean up the entire project area and return the ground cover to grade. All excess material and debris not incorporated into the permanent installation shall be disposed of by CONTRACTOR.

406.10 MEASUREMENT AND PAYMENT

406.10.1 Pipeline Reaming shall be paid for at the Contract Unit Price as follows: The unit price shall cover the entire cost of pipe, measured to the nearest 0.1', center to center of manhole, less 1/2 the diameter of both the upstream and downstream manholes.

406.10.2 Obstruction Removal shall be paid for at the bid unit price for obstruction removal.

406.10.3 Payment for service connection shall be paid for at the unit price bid for service connection.

406.10.4 The prices shall be payment in full for performing and completing the work and for furnishing all labor and materials necessary including removal of existing structure, pipe materials, surface restoration, all testing, and all incidental costs.

PART 407 – PIPE CRUSHING

407.1 GENERAL

- 407.1.1 Pipe crushing: The pipe crushing process is defined as the reconstruction of existing sanitary sewers by the simultaneous insertion of a pipe within the bore of the existing pipe, by breaking and expanding the old pipe.
- 407.1.2 The pipe crushing process involves rehabilitation of deteriorated gravity sewer pipe by installing new pipe material within the enlarged bore created by using a static, hydraulic, or pneumatic hammer moling device, suitably sized to break the old pipe or by using a modified boring knife with a flared plug that crushes the existing sewer pipe. Forward progress of the mole or the knife may be aided by hydraulic equipment or other apparatus. Replacement pipe is pushed into the bore.
- 407.1.3 Pipe Crushing existing sanitary sewers governs all work, materials, and testing for installation of pipe by trenchless method of installing new sewer pipe as shown on the Drawings and in conformity with these specifications.
- 407.1.4 Rights-of-Way clearing and restoring, excavation and backfill, insertion or access pits, embedment (bedding and backfill), field quality control (testing), sealing at manhole, grouting annular space, building up, shaping and reworking the manhole inverts and benches, and pre-installation and post-installation televising of completed work shall be incidental to installation of pipe crushing.
- 407.1.5 Excavations used for insertion pit shall be considered as an insertion pit and not paid separately.
- 407.1.6 Trench safety systems, well pointing, backfill with cement-stabilized sand or bank sand, and other applicable items associated with insertion pits will not be paid separately.
- 407.1.7 Submit manufacturer's product data with complete information on pipeline materials, physical properties, and dimensions pertinent to this job. Furnish a certificate of compliance with specifications for materials to be supplied.
- 407.1.8 Prevent injury or abrasion to pipe during loading, transportation, and unloading. Do not drop pipe from cars or trucks, nor allow pipe to roll down skids without proper restraining ropes. Use suitable pads, strips, skids, or blocks for each pipe during transportation and while awaiting installation in the field.
- 407.1.9 Safety. CONTRACTOR shall carry out his operation in accordance with OSHA standards and recommended safety standards of the manufacturer. Particular attention is directed to safety standards and practices applicable to work performed involving scaffolding and confined spaces.

407.2 REFERENCE SPECIFICATIONS

- 407.2.1 ASTM A746 – Ductile Iron Gravity Sewer Pipe.

407.2.2 ASTM C1208 – Vitrified Clay Jacking Pipe.

407.3 MATERIALS

407.3.1 Pipe shall be Ductile Iron Gravity Service Bell-less Push Pipe Rubber Gasket Coupled Joint/Class 55 manufactured by American Ductile Iron Pipe or equal, or

407.3.2 Pipe shall be Vitrified Clay Jacking Pipe manufactured by Mission Clay Pipe Industries or equal, or

407.3.3 Pipe shall be Fastite Joint Push-Bar Pipe manufactured by American Cast Iron Pipe Company or equal.

407.4 EXECUTION

407.4.1 Locate insertion or access pits so that the total number is minimized, and footage of pipe installed in a single run is maximized. Use excavations at point repair locations for insertion pits, where possible.

407.4.2 Before excavating, check with various utility companies and determine the location of utilities in the vicinity of the work area. For damage done to utilities, the resulting repair, temporary service, and other such costs shall be borne by CONTRACTOR.

407.4.3 Perform excavation and backfill in accordance with the City of Tulsa Specifications.

407.4.4 Install and operate necessary dewatering and surface water control measures in accordance with requirements of Part 111 – Dewatering.

407.5 PIPE INSTALLATION

407.5.1 Joints: Assemble and join sections as recommended by the manufacturer.

407.5.2 Preparation: After completing insertion pit excavation, remove top of existing sanitary sewer line down to the spring line. Connect a Pipe Crushing system to the end of the pipe by use of a suitable pushing head equal to or greater than the outside diameter of pipe. Secure the pushing head to pipe and attach to Pipe Crushing system so that pipe can be satisfactorily fed and pushed through sanitary sewer main. Refer to insertion procedures given in ASTM F585.

407.5.3 Apply pushing force to pipe wall end in accordance with Table No. 1, and manufacturer's instructions. Maximum allowable joint angular deflection shall be 3.0 degrees.

Table No. 1 GS Push Pipe – Allowable Thrust Loads

Pipe Size (Inches)	Uniform Pipe Outside Diameter (Inches)	Nominal Pipe Wall Thickness (Inches)	Allowable Thrust Load (pounds)
4	4.80	0.41	60,000
6	6.90	0.43	124,000
8	9.05	0.45	176,000
10	11.10	0.47	232,000
12	13.20	0.49	294,000
14	15.30	0.51	362,000
16	17.40	0.52	424,000

407.6 BYPASSING SEWAGE

407.6.1 CONTRACTOR, when required, shall provide for the flow of sewage around the section or sections of pipe that are to be rehabilitated. The bypass shall be made by plugging the line at an existing upstream manhole and pumping the flow into a downstream manhole or adjacent system. The pump and bypass lines shall be of adequate capacity and size to handle anticipated wet weather flow.

407.7 INTERRUPTION OF SERVICE

407.7.1 When preparing for making connection to the existing system or other work, which will interrupt service to the utility users, CONTRACTOR shall notify the affected user at least 48 hours in advance of service interruption, stating the approximate time and duration of interruption of service. Advance notification shall not extend beyond 72 hours. CONTRACTOR shall coordinate with the authorities having jurisdiction, any necessary interruption of service and shall limit such interruption to the duration mutually agreeable to both parties.

407.8 SERVICE CONNECTIONS

407.8.1 After the replacement pipe has been secured, service connections shall be excavated and reconnected to the new pipe. All service connections to existing buildings are to be reconnected, except where disconnection is approved by the Engineer. Service connection to a vacated lot shall not be reconnected. If more than one service is found per lot, then the Contractor shall verify that service connections are active by introducing dye into the lines at cleanouts, vents stacks or other access points as approved by the Engineer. Dye testing shall be recorded by CCTV inspection at the location in the main line where the dye appears. All addresses will be noted on log sheets for future references. Provide the address of all reconnected and disconnected services. The replacement pipe shall be exposed to provide adequate working space for making the new service connection. Service laterals shall be connected to the liner pipe using approved saddle connections, INSERTATEE, or equal. Service interruptions to any homes tributary to the sewer line being rehabilitated shall not exceed 36 hours. Care shall be used not to damage the pipe. If damage occurs as a result of the Contractor's operations, the Contractor shall assume all cost associated with the repair of the pipe.

407.9 MANHOLE REPLACEMENT

407.9.1 In those places where the insertion pit shaft is excavated at an existing manhole, the manhole shall be replaced with a new manhole conforming to Part 416, Complete Manhole Replacement and in accordance with the Details. Where manhole replacement is specified at locations not scheduled to be an insertion pit, The CONTRACTOR may, at the discretion of the ENGINEER, do a complete rehabilitation of the manhole in accordance with Parts 416 through 421. Costs for such work are incidental to the project and shall be the responsibility of CONTRACTOR.

407.10 SEALING IN MANHOLE

407.10.1 Reshape and smooth the manhole invert as specified in Part 416 Complete Manhole Replacement. Use approved manhole rehabilitation material to form a smooth transition with a reshaped invert and a raised manhole bench to eliminate sharp edges of liner pipe, concrete bench, and channeled invert. Build up and smooth invert of manhole to match flow line of new liner.

407.10.2 Pipe Seals shall be repaired in accordance with Construction Specifications Part 314 Manhole.

407.11 BACKFILL

407.11.1 At all points where the pipe has been exposed (such as at the insertion pit or at service connection fittings), the pipe and fittings shall be encased in concrete as specified by ENGINEER to prevent deflection due to earth loading or subsidence.

407.11.2 After the encasement material is in place and accepted by Engineer, backfill shall be placed and compacted to require finished grade in accordance with Part 302 Excavation and Backfill, 402 Restoration, and 403 Backfill.

407.12 FINAL ACCEPTANCE

407.12.1 After installation of the replacement pipe, CONTRACTOR shall TV inspect the sewer line as specified and perform the following test on the sewer line.

407.12.2 Testing. After installation and before any service connections are reinstated, CONTRACTOR shall run a test on the sewer line to determine if it is watertight.

407.12.3 CONTRACTOR shall furnish all necessary equipment to conduct the test. An acceptable method is a low-pressure air test, conducted as follows:

A) Pressurize the test section to 4.0 psi and hold above 3.5 psi for not less than two minutes. Add air if necessary, to keep the pressure above 3.5 psi. At the end of this two-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.

Carrier Pipe Diameter (inches)	Minimum Elapsed Time (minutes)
8	4
10	5
12	6
15	7
18	8
21	10
24	13
27	15
30	18

- B) When the prevailing groundwater is above the sewer being tested, test pressure shall be increased 0.43 psi for each foot that the water table is above the invert of the sewer.
- C) 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.
- D) If building service connections have been reinstated before the air test, they shall be considered part of the pipe to which they are connected, and no adjustment of test time shall be allowed.
- E) The pressure gauge used shall be supplied by CONTRACTOR and have minimum divisions of 0.10 psi and shall have an accuracy of 0.004 psi.

407.12.4 Payment for air pressure tests, including the furnishings and installing of all equipment and materials, conducting the pressure test, and making all necessary repairs shall be considered as incidental to the Contract amount.

407.13 CLEANUP

407.13.1 After the installation work has been completed and all testing acceptable, CONTRACTOR shall clean up the entire project area and return the ground cover to grade. All excess material and debris not incorporated into the permanent installation shall be disposed of by CONTRACTOR.

407.13.2 Upon completion of installation work and testing, clean and restore project area affected by the Work. Restoration shall be in accordance with Part 301 – Rights of Way Cleaning and Restoring, Part 302 Excavation and Backfill, Part 402 Restoration, and Part 403 Backfill.

407.14 MEASUREMENT AND PAYMENT

407.14.1 Pipe Crushing Sanitary Sewers shall be paid for at the Contract Unit Price as follows: The unit price shall cover the entire cost of pipe, measured to the nearest 0.1', center

to center of manhole, less 1/2 the diameter of both the upstream and downstream manholes.

407.14.2 Obstruction Removal shall be paid for at the bid unit price for obstruction removal.

407.14.3 Payment for service connection shall be paid for at the unit price bid for service connection.

407.14.4 The prices shall be payment in full for performing and completing the work and for furnishing all labor and materials necessary, including removal of existing structure, pipe material, all testing, bypass pumping, and all incidental costs.

PART 408 – PIPE BURSTING

408.1 GENERAL

- 408.1.1 Pipe bursting: Trenchless pipe enlargement consists of the enlargement of an existing pipeline without wholesale excavation of the pipeline. Excavation is normally performed only to reconnect services or to construct an insertion or retrieval pit. Trenchless pipe enlargement shall be conducted with a hydraulic pulling or pushing apparatus and a pipe expander. The pipe expander shall be pushed or pulled through the existing pipe on grade, widening the existing pipe material sufficiently to accommodate the insertion of the new pipe material (replacement pipe). The Contractor shall furnish for the Engineer's approval, a plan showing his proposed method of installation, including the design of the equipment, location of pits, direction and length of pulls, equipment support or backstop, arrangement and position of jacks, pipe guides, etc., complete in assembled position. The approval of this plan by the Engineer will not relieve the Contractor from his responsibility to obtain the specified results.
- 408.1.2 Rights-of-Way clearing and restoring, excavation and backfill, insertion or access pits, embedment (bedding and backfill), field quality control (testing), sealing at manhole, grouting annular space, building up, shaping and reworking the manhole inverts and benches, and pre-installation and post-installation televising of completed work shall be incidental to installation of pipe crushing.
- 408.1.3 Excavations used for insertion pit shall be considered as an insertion pit and not paid separately.
- 408.1.4 Trench safety systems, well pointing, backfill with cement-stabilized sand or bank sand, and other applicable items associated with insertion pits will not be paid separately.
- 408.1.5 Submit manufacturer's product data with complete information on pipeline materials, physical properties, and dimensions pertinent to this job. Furnish a certificate of compliance with specifications for materials to be supplied.
- 408.1.6 Prevent injury or abrasion to pipe during loading, transportation, and unloading. Do not drop pipe from cars or trucks, nor allow pipe to roll down skids without proper restraining ropes. Use suitable pads, strips, skids, or blocks for each pipe during transportation and while awaiting installation in the field.
- 408.1.7 Safety. Contractor shall carry out his operation in accordance with OSHA standards and recommended safety standards of the manufacturer. Particular attention is directed to safety standards and practices applicable to work performed involving scaffolding and confined spaces.

408.2 MATERIALS

- 408.2.1 Materials allowed for trenchless pipe enlargement will be polyethylene pipe or ductile iron pipe. Polyethylene pipe shall be formulated of high-density polyethylene resin

conforming to ASTM D1248, and shall meet requirements for Type III, Class B, Grade P34, Category S, and PPI rating of PE 3408, when compounded. The pipe produced from the resin shall have a minimum cell classification of 345434 D or E under ASTM D3350. Polyethylene pipe shall have a maximum SDR value of 17, a minimum working pressure of 100 psi, and an inside diameter equivalent to the existing pipe or selected pipe size.

408.2.2 Ductile iron pipe shall be American Ductile Iron GS push pipe, Fastite Joint Push-Bar, Flex-Ring Joint Pipe, or approved equal.

408.2.3 HDPE shall be stored per 409.6.2.

408.3 EXECUTION

408.3.1 Locate insertion or access pits so that the total number is minimized, and footage of pipe installed in a single run is maximized. Use excavations at point repair locations for insertion pits, where possible.

408.3.2 Before excavating, check with various utility companies and determine the location of utilities in the vicinity of the work area. For damage done to utilities, the resulting repair, temporary service, and other such costs shall be borne by Contractor.

408.3.3 Perform excavation and backfill in accordance with the City of Tulsa, Specifications.

408.3.4 Install and operate necessary dewatering and surface water control measures in accordance with requirements of Part 111 – Dewatering.

408.4 PIPE INSTALLATION

408.4.1 GENERAL: Prior to installation, the Contractor shall thoroughly clean the existing line and conduct a closed-circuit television inspection of the same. Television inspection shall be in accordance with other requirements of this specification.

408.4.2 The Contractor shall maintain sewage flow at all times. When acceptable, the Contractor will be allowed to plug the upstream line and store flows in the upstream line segments. When inadequate storage exists to make this alternative acceptable, bypass pumping shall be required. The Contractor shall submit a plan describing the methods he intends to utilize for maintaining sewage flow.

408.4.3 Suitable pit shafts, or trenches shall be excavated for the purpose of conducting the trenchless operations and for placing end joints of the pipe. Wherever end trenches are cut in the sides of the embankment or beyond it, such work shall be sheeted securely and braced in a manner to prevent earth caving. The pits or trenches excavated to facilitate the operations shall be backfilled immediately after the pipe has been installed and tested.

408.4.4 Once insertion is initiated, the Contractor shall complete the insertion without interruption.

408.4.5 The pipe shall be laid true to the lines and grades within the existing sewer as shown on the Contract Drawings. The Contractor's operations shall be conducted to prevent damage to the liner or to adjacent facilities. The City shall inspect all pipe and fittings before and after installation.

A) Where the existing main to be replaced is less than 2' deep, all utilities and services crossing the main or running parallel to it, and lying within a distance of 2' horizontal from the edge of the existing line shall be exposed prior to pipe bursting.

B) Where the existing main to be replaced is between 2' and 4' deep, all utilities and services crossing the main or running parallel to it, and lying within a distance of 2' horizontal from the edge of the existing line shall be exposed prior to pipe bursting.

408.4.6 After insertion, the liner, if polyethylene pipe, shall be allowed a minimum of 12 hours (or as otherwise recommended by the pipe manufacturer) to reach temperature equilibrium with the sewer and to stress-relieve itself. No connection shall be made to the liner during this period. The Contractor is cautioned that he must pull such additional length of pipe as is required to compensate for contraction during this period.

408.4.7 HDPE shall be installed per 409.13.2, 409.13.3, 409.13.4, and 409.13.5.

408.5 BYPASSING SEWAGE

408.5.1 Contractor, when required, shall provide for the flow of sewage around the section or sections of pipe that are to be rehabilitated. The bypass shall be made by plugging the line at an existing upstream manhole and pumping the flow into a downstream manhole or adjacent system. The pump and bypass lines shall be of adequate capacity and size to handle anticipated wet weather flow.

408.6 INTERRUPTION OF SERVICE

408.6.1 When preparing for making connection to the existing system or other work, which will interrupt service to the utility users, Contractor shall notify the affected user at least 48 hours in advance of service interruption, stating the approximate time and duration of interruption of service. Advance notification shall not extend beyond 72 hours. Contractor shall coordinate with the authorities having jurisdiction, any necessary interruption of service and shall limit such interruption to the duration mutually agreeable to both parties.

408.7 SERVICE CONNECTIONS

408.7.1 After the replacement pipe has been secured, service connections shall be excavated and reconnected to the new pipe. All service connections to existing buildings are to be reconnected, except where disconnection is approved by the Engineer. Service connection to a vacated lot shall not be reconnected. If more than one service is found per lot, then the Contractor shall verify that service connections are active by introducing dye into the lines at cleanouts, vents stacks, or other access points as

approved by the Engineer. Dye testing shall be recorded by CCTV inspection at the location in the main line where the dye appears. All addresses will be noted on log sheets for future references. Provide the address of all reconnected and disconnected services. The replacement pipe shall be exposed to provide adequate working space for making the new service connection. Service laterals shall be connected to the liner pipe using polyethylene heat fusion saddle, strap on saddle, or INSERTATEE on polyethylene pipe; and strap on saddle, INSERTATEE, or equal on ductile iron pipe. Service interruptions to any homes tributary to the sewer line being rehabilitated shall not exceed 36 hours. Care shall be used not to damage the pipe. If damage occurs as a result of the Contractor's operations, the Contractor shall assume all cost associated with the repair of the pipe.

408.8 MANHOLE REPLACEMENT

408.8.1 In those places where the insertion pit shaft is excavated at an existing manhole, the manhole shall be replaced with a new manhole conforming to Part 416, Complete Manhole Replacement and in accordance with the Details. Where manhole replacement is specified at locations not scheduled to be an insertion pit, the Contractor may, at the discretion of the City and Engineer, do a complete rehabilitation of the manhole in accordance with Parts 416 through 420. Costs for such work are incidental to the project and shall be the responsibility of Contractor.

408.9 SEALING IN MANHOLE

408.9.1 Reshape and smooth the manhole invert as specified in Part 416. Complete Manhole Replacement. Use approved manhole rehabilitation material to form a smooth transition with a reshaped invert and a raised manhole bench to eliminate sharp edges of liner pipe, concrete bench, and channeled invert. Build up and smooth invert of manhole to match flow line of new liner.

408.9.2 Pipe Seals shall be repaired in accordance with the City of Tulsa Specifications, Part 314, Manhole.

408.10 BACKFILL

408.10.1 At all points where the pipe has been exposed (such as at the insertion pit or at service connection fittings), the pipe and fittings shall be encased in concrete as specified by Engineer to prevent deflection due to earth loading or subsidence.

408.10.2 After the encasement material is in place and accepted by Engineer, backfill shall be placed and compacted to require finished grade in accordance with Part 302 Excavation and Backfill, 402 Restoration, and 403 Backfill.

408.11 FINAL ACCEPTANCE

408.11.1 After installation of the replacement pipe, Contractor shall TV inspect the sewer line as specified and perform the following test on the sewer line.

408.11.2 Testing. After installation and before any service connections are reinstated, Contractor shall run a test on the sewer line to determine if it is watertight.

408.11.3 Contractor shall furnish all necessary equipment to conduct the test. An acceptable method is a low-pressure air test, conducted as follows:

A) Pressurize the test section to 4.0 psi and hold above 3.5 psi for not less than two minutes. Add air if necessary, to keep the pressure above 3.5 psi. At the end of this two-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.

Carrier Pipe Diameter (Inches)	Minimum Elapsed Time (Minutes)
8	4
10	5
12	6
15	7
18	8
21	10
24	13
27	15
30	18

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

C) 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.

D) If building service connections have been reinstated before the air test, they shall be considered part of the pipe to which they are connected, and no adjustment of test time shall be allowed.

E) The pressure gauge used shall be supplied by Contractor and have minimum divisions of 0.10 psi and shall have an accuracy of 0.0004 psi.

408.11.4 Payment for air pressure tests, including the furnishings and installing of all equipment and materials, conducting the pressure test, and making all necessary repairs shall be considered as incidental to the contract amount.

408.12 CLEANUP

408.12.1 After the installation work has been completed and all testing acceptable, Contractor shall clean up the entire project area and return the ground cover to grade. All excess material and debris not incorporated into the permanent installation shall be disposed of by Contractor.

408.12.2 Upon completion of installation work and testing, clean and restore project area affected by the work. Restoration shall be in accordance with Part 301 – Rights of Way Cleaning and Restoring, Part 302 Excavation and Backfill, Part 402 Restoration, and Part 403 Backfill.

408.13 MEASUREMENT AND PAYMENT

408.13.1 Pipe bursting Sanitary Sewers shall be paid for at the Contract Unit Price as follows: The unit price shall cover the entire cost of pipe, measured to the nearest 0.1', center to center of manhole, less 1/2 the diameter of both the upstream and downstream manholes.

408.13.2 Obstruction Removal shall be paid for at the bid unit price for obstruction removal.

408.13.3 Payment for service connection shall be paid for at the unit price bid for service connection.

408.13.4 The prices shall be payment in full for performing and completing the work and for furnishing all labor and materials necessary, including removal of existing structure, pipe material, all testing, and all incidental costs.

PART 409 – SLIPLINING

409.1 GENERAL

409.1.1 The intent of sliplining is to rehabilitate sanitary sewer lines by the insertion of a polyethylene liner pipe into the existing sewer lines as indicated on the Drawings. When complete, the liner pipe should extend from one manhole to the next manhole in a continuous, watertight length. Sliplining is the renovation of an existing sewer line by inserting a polyethylene liner. This procedure requires an insertion pit as well as reconnection pits for re-connecting services. Sliplining shall be in accordance with ASTM F585.

409.2 REFERENCE SPECIFICATIONS

409.2.1 This Specification references American Society for Testing and Materials (ASTM) standard specifications, which are made a part hereof by such reference and shall be the latest edition and revision thereof.

409.2.2 D1248 Specification for Polyethylene Plastics Molding and Extrusion Materials

409.2.3 D1693 Test for Environmental Stress-Cracking of Ethylene Plastics

409.2.4 D2122 Determining Dimensions of Thermoplastic Pipe and Fittings

409.2.5 D2657 Practice for Heat-Jointing Polyolefin Pipe and Fittings

409.2.6 D2837 Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials

409.2.7 D3035 Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Controlled Outside Diameter (up to 6" IPS)

409.2.8 D3350 Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Controlled Outside Diameter (up to 6" IPS)

409.2.9 F585 Practice for Insertion of Flexible Polyethylene Pipe into Existing Sewers

409.2.10 F714 Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter (3" IPS and larger)

409.2.11 Section 702, Table 702.3 (Building Sewer Pipe) and Table 702.4 (Pipe Fittings) of the International Plumbing Code (IPC) 1997

409.3 MATERIALS

409.3.1 The following materials are approved for installation in sanitary sewer lines:

- 409.3.2 The sewer liner pipe and fittings shall be manufactured from a polyethylene compound, which conforms to ASTM D1248 and meets the requirements for Type II or III, Class B, Grades P23 or P 24, Category 5.
- 409.3.3 Pipe made from this compound must have a long-term hydrostatic strength rating of 1,250 psi or more, in accordance with ASTM D2837.
- 409.3.4 When the environmental stress crack resistance (ESCR) of the compound is measured in accordance with ASTM D1693, Condition C, the compound shall withstand not less than 192 hours in 100% solution of CO-630 at 100° F before reaching 20% failure point (F20).
- 409.3.5 Sliplining pipe interior color shall be white or very light.

409.4 LINER MATERIAL TESTS

- 409.4.1 Tests for compliance with this Specification shall be made according to the applicable ASTM Specification. A certificate of compliance with this Specification upon request shall be provided by the manufacturer for all material furnished under this Specification. In addition, CONTRACTOR may, at his own expense, witness inspection and test of the materials, when requested at the time of purchase.

409.5 LINER PIPE DIMENSIONS

- 409.5.1 The outside diameter and minimum wall thickness shall conform to dimensions listed in Table I when measured in accordance with ASTM D2122. Where construction difficulties prevent the use of these pipe sizes; other pipe sizes may be specified following Engineer’s approval.

TABLE I
Max. SDR vs. Depth of Sewer Line

Depth	For Lining Max SDR
0' – 8'	26.0
Over 8' to 14'	21.0
Over 14' to 19'	19.0
Over 19' to 26'	17.0
Over 26' to 33'	15.5

- 409.5.2 For line segments to be rehabilitated due to structural failure of the existing sewer pipe, minimum pipe wall thickness of the liner shall be SDR 21.

TABLE II
Sliplining Pipe Dimensions (Inches)

Size of Sewer	OD of Liner	Nominal OD	Minimum Wall Thickness			
			SDR 26	SDR 21	SDR 17	SDR 15.5
8	7.125	7.125"	0.274	0.339	0.419	0.460
10	8.625	8" IPS	0.332	0.411	0.507	0.556
12	10.75	10" IPS	0.413	0.512	0.632	0.694
15	13.38	13.380"	0.515	0.637	0.787	0.863
18	16.00	16" IPS	0.615	0.762	0.941	1.032
21	18.70	18.700"	0.719	0.890	1.100	1.206

409.5.3 The Standard Dimension Ratios (SDR's) are: 26, 21, 17, and 15.5. These are referred to as SDR 26, SDR 21, SDR 17 and SDR 15.5. Standard Dimension Ratio is calculated by dividing the specified outside diameter by the minimum wall thickness. The wall thickness tolerance shall be within plus 12%.

409.6 STORAGE

409.6.1 Pipe lengths shall be stored in such a location and manner as to eliminate the possibility of scoring, gouging, or otherwise damaging the pipe. Sections of the pipe shall be assembled and joined together prior to insertion of the pipe. Assembly shall be accomplished above ground. If the liner is to be dragged when transported or inserted, then sleds, rollers or other similar devices shall be furnished and utilized by the CONTRACTOR to protect the pipe wall from damage due to cuts, gouges, or scrapes.

409.6.2 When HDPE pipe is delivered to the jobsite it shall not be exposed to sunlight for more than three (3) weeks. HDPE pipe exposed to sunlight for more than three (3) weeks shall be covered with an opaque protective covering. The pipe shall be left stacked and no more pipe than can be installed in one day shall be strung along the jobsite.

409.7 REJECTION

409.7.1 Any materials may be rejected for failure to meet any of the requirements of this Specification.

409.8 INSTALLATION: THE FOLLOWING INSTALLATION PROCEDURES SHALL BE ADHERED TO UNLESS OTHERWISE APPROVED BY CITY.

409.9 CLEANING OF SEWER LINE

409.9.1 It shall be the responsibility of CONTRACTOR to clear the line of all obstructions, solids, dropped joints, or collapsed pipe that will prevent the insertion of the liner. Protruding service connections shall be removed to allow insertion of the liner without damage or scoring of the exterior pipe surface. If inspection reveals an obstruction that is not at the location of the entry shaft, CONTRACTOR shall make an excavation to expose and remove or repair the obstruction. Such point repair shall be approved in

writing by the Engineer prior to commencement of the work and is considered a separate pay item.

409.10 TELEVISION INSPECTION

409.10.1 The CONTRACTOR shall CCTV inspect all sewer lines to be lined, utilizing a color video inspection system with data recording capabilities on Standard Transfer Media. Both a video recording and written log identifying all service connections and openings shall be furnished to the Engineer and become the property of the owner. The entire line segment between manholes shall be videoed.

409.11 BYPASSING SEWAGE

409.11.1 CONTRACTOR shall, as required, bypass the wastewater around the section or sections of line that are to be sliplined if the annular space and pulling head openings are incapable of handling the flow. The bypass shall be made by plugging an existing upstream manhole, if necessary, and pumping the sewage into a downstream manhole or adjacent system. The pump and bypass lines shall be of adequate capacity and size to handle anticipated wet-weather flow.

A) At the end of each working day, a temporary tie-in shall be made between the relined section and the existing system and the bypass plug removed.

409.12 EXCAVATION

409.12.1 Where excavations for insertion of the polyethylene liner are made in a line section between two manholes, CONTRACTOR will establish the excavation points on the basis of location of the lines to be sliplined, pushing distances, and traffic conditions. The locations of the excavation points shall be such as to minimize traffic disruption. The number of excavations will be reduced by planning to insert the pipe in both directions from a single opening. Sheathing and bracing requirements will depend on depth and ground conditions and CONTRACTOR shall determine the necessity for such sheathing and bracing. The top of the existing sewer line shall be exposed to the spring line and the crown of the pipe shall be removed as necessary for insertion of the liner. Care should be taken not to disturb the bottom portion of the existing sewer line, as this will afford a stable base for the liner pipe.

409.12.2 The location of the pits shall be determined by the CONTRACTOR and submitted to the ENGINEER for approval. Insertion may be from two directions. The insertion pits shall be long enough to avoid imposing a bending radius of less than 35 times the outside diameter of the pipe liner during insertion and shall be sloped gradually from the ground surface to the top of the pipe. The width of the insertion pit(s) shall be sufficient to allow the entry of workmen. Trench supports must be positioned so as not to affect insertion. Neither winch cable nor sliplining pipe shall touch the support system.

409.13 PIPE JOINING

- 409.13.1 Sections of the polyethylene pipe shall be assembled and joined prior to insertion of the pipe.
- 409.13.2 Pipe and fittings shall be joined by one of the following types of thermal fusion per the Manufacturer's recommended procedures: Butt fusion, Saddle fusion, or Socket fusion.
- 409.13.3 Polyethylene pipe and fittings may be joined together or to other materials using electrofusion fittings, flange adapters with back-up rings, mechanical couplings designed for connecting polyethylene pipe and fittings to itself or to another material, or MJ adapters. The manufacturer of the joining device shall be consulted for proper installation procedures.
- 409.13.4 Polyethylene pipe and fittings joined together using a hydraulically operated heat butt fusion machine, shall utilize a data recording device per ASTM F3124 – STANDARD PRACTICE FOR DATA RECORDING THE PROCEDURE USED TO PRODUCE HEAT BUTT FUSION JOINTS IN PLASTIC PIPING SYSTEMS OR FITTINGS. Each HDPE joint shall be traceable to the fusion operator and equipment. Electrofusion reports of each weld shall be appropriately identified and provided to City of Tulsa Inspector. The reports shall include, as a minimum, the fusion date, time, ambient temperature, fitting type and size, user ID, and the manufacturer of the part.
- 409.13.5 The Contractor shall be responsible for ensuring all personnel operating heat fusion equipment are qualified Heat Fusion Equipment Operators in accordance with ASTM F3190-16 – STANDARD PRACTICE FOR HEAT FUSION EQUIPMENT (HFE) OPERATOR QUALIFICATION ON POLYETHYLENE (PE) AND POLYAMIDE (PA) PIPE AND FITTINGS. All polyethylene joints shall be thermally butt fused by an HFE Operator. The HFE Operators Card shall be submitted at the Pre-Construction Conference and provided at the request of the Engineer. Certification by a distributor shall not be an acceptable substitute.
- 409.13.6 Joints between pipe sections shall be smooth on the inside and internal projection beads shall not be greater than 3/16". All completed joints shall be watertight at the rated pressure for the pipe and shall have strength characteristics equal to or greater than the pipe itself. Improperly made or damaged joints shall be repaired or replaced as directed by the Engineer at the Contractor's expense. The ENGINEER shall be provided with samples of butt fused joints for testing upon request.
- 409.13.7 Use of a stainless-steel full encirclement clamp or the installation of a new manhole may accomplish joining of the liner, in cases where the insertion pit is not at a manhole. Minimum clamp length shall be in accordance with the following table:

Liner Pipe O.D. (Inches)	Clamp Minimum Length (Inches)
Less than 4.0	7.5
4.0 thru 5.375	10.0
6.0 thru 8.625	15.0
9.0 thru 13.375	20.0
14.0 thru 28.0	30.0
29.0 thru 36.0	48.0
Over 36.0	60.0

409.14 INSERTION OF THE LINER

- 409.14.1 Prior to inserting the polyethylene liner, the CONTRACTOR shall excavate each active sewer service tap at the locations discovered by the pre-construction TV inspection and as directed by the ENGINEER.
- 409.14.2 Before insertion, the pulling of a "sizing pig" through the existing sewer is required. The "pig" can be fabricated with pulling heads on each end of a piece of plastic liner approximately 8' long, of the same diameter as the pipe to be inserted. This will prevent any difficulties with long lengths of pipe becoming stuck in insertion by insuring that offset joints and tilted sections can be cleared. The sizing pig shall be equipped with a tag line so that it can be retrieved, if necessary. The sizing pig and the liner shall be lubricated in such a manner and with such materials as recommended by the pipe manufacturer.
- 409.14.3 The polyethylene liner shall be inserted into the existing sewer line with a power winch and a steel cable connected to the end of the liner by use of an appropriate pulling head. A second pulling head may be attached to the other end of the liner for attachment of a tag line to pull the liner back out of the sewer line, if necessary. The winch drum capacity and winching power available and consideration of the size and condition of the sewer shall govern length of the liner pipe to be inserted at any one time.
- 409.14.4 During insertion, precautions shall be taken to protect the liner pipe to prevent the ragged edges of the broken sewer pipe from scoring the outside of the liner as it is being pulled into the sewer. Excessive grooving of liner will be cause for rejection as determined by ENGINEER. Caution must be taken not to stretch the polyethylene pipe beyond its elastic limit in the event of an impediment. The CONTRACTOR shall maintain on hand such equipment as might be required to withdraw the liner.
- 409.14.5 Once the insertion is initiated, it is desirable to continue the pull to completion without interruption.
- 409.14.6 After insertion, the liner shall be allowed a minimum of 25 hours (or as otherwise recommended by the pipe manufacturer) to reach temperature equilibrium with the sewer and to stress-relieve itself. No connections shall be made to the liner during this period. The CONTRACTOR is cautioned that he must pull such additional length of polyethylene pipe as is required to compensate for contraction during this period.

- 409.14.7 Upon completion of the lining of each section, the material previously cut out of the existing line to allow insertion of the liner shall be replaced. The entire cut section of pipe shall then be capped with lean concrete. The lean concrete shall extend 2' past each end of the cutout. The concrete shall be placed against undisturbed earth at the sides of the excavation and to a point 12" above the top of the liner. The CONTRACTOR shall take whatever precautions are necessary to protect the concrete as it cures and to prevent the polyethylene liner from rising off the existing water invert during placement of the concrete.
- 409.14.8 The concrete shall be placed in such manner that it will not place any undue stress on the polyethylene liner.
- 409.14.9 After the concrete has had at least 24 hours to set up, the CONTRACTOR shall backfill the insertion pit and restore the pit area to its original condition, including replacement of all obstructions affected by the construction of the project, including, but not limited to, fences, retaining walls, patios, signs, mailboxes, outbuildings, landscaping, sidewalks, paving, etc.

409.15 MANHOLE REPLACEMENT

- 409.15.1 In those places where the entrance shaft is excavated at an existing manhole, the manhole shall be replaced with a new manhole conforming to Part 416 COMPLETE MANHOLE REPLACEMENT of the Specifications for manhole construction and in accordance with the Drawings. Costs for such work are incidental to the project and shall be the responsibility of the CONTRACTOR. If the manhole was scheduled for replacement, it will be paid for at the unit price bid for Manhole Replacement.
- 409.15.2 Where a lamphole exists at the end of a line segment being sliplined, a transition coupling shall be used at the end of the polyethylene liner to connect it to standard lamphole pipe and fittings. Existing lampholes constructed of materials other than DIP or PVC shall be replaced with a new lamphole conforming to PART 417 REPLACEMENT OF CLEANOUT / LAMPHOLE AND/OR CLEANOUT / LAMPHOLE FRAME AND COVER. Prior to backfilling, the annular space adjacent to the transition coupling shall be filled with polyurethane foam, 3M Scotch-Seal 5600, or equal, for a distance of at least 6" from the transition coupling. The intent of this polyurethane foam is to seal the sewer line so that no solids or liquids enter the annular space. Costs for such work shall be paid for separately in accordance with PART 417.

409.16 SEALING POLYETHYLENE PIPE IN MANHOLES

- 409.16.1 The polyethylene pipe liner shall be pulled through all manholes except terminal manholes within the sliplining areas. After the liner has reached temperature equilibrium and stress-relieved itself, the lining shall be cut and finished, as required. The annular space between the existing sewer line and the slipliner shall be filled with expanding polyurethane foam, 3M Scotch-Seal 5600 and Oakum, or equivalent, for a distance of at least 12" along the liner and all the way around the liner, at each end of the liner pipe. This shall result in a seal between the slipliner pipe and each manhole.

The existing inlet and outlet shall be grouted as directed by the Inspector to prevent infiltration. The invert of the manhole shall be repaired and grouted to provide a smooth transition between inlet and outlet and to prevent ponding.

- 409.16.2 At those manholes where pipe liner size changes occur or where lateral sewers enter, the CONTRACTOR shall mate and cut the liners in such a manner as to provide a smooth transition. The CONTRACTOR shall submit his proposed methods to the ENGINEER for approval.

409.17 SERVICE CONNECTIONS

- 409.17.1 After the liner has been secured in the upstream manhole, service connections shall be excavated and reconnected to the new liner. A minimum relaxation period of 24 hours will be required of CONTRACTOR prior to the connection of service laterals. All service connections to existing buildings are to be reconnected, except where disconnection is approved by the Engineer. Service connection to a vacated lot shall not be reconnected. If more than one service is found per lot, then the Contractor shall verify that service connections are active by introducing dye into the lines at cleanouts, vents stacks or other access points as approved by the Engineer. Dye testing shall be recorded by CCTV inspection at the location in the main line where the dye appears. All addresses will be noted on log sheets for future references. Provide the address of all reconnected and disconnected services. A portion of the existing sewer, at the liner pipe, around each service connection shall be removed to expose the liner pipe to provide adequate working space for making the new service connection. Service laterals shall be connected to the liner pipe using polyethylene heat fusion saddles, strap-on (wrap around) saddles, INSERTATEE, or equal. Strap-on saddles shall be secured to the liner pipe using stainless steel bands. A neoprene gasket shall be inserted between the liner and the strap-on saddle.

- 409.17.2 The CONTRACTOR shall remove any fallen pipe, bricks, mortar, earth, or other material from the annular space. Service laterals shall be connected to the liner pipe, using polyethylene heat fusion saddles or PVC saddles.

- 409.17.3 If PVC saddles are used, they shall be made of Type 1, Grade 1, PVC Resin per ASTM Spec. D1784-81. The saddle shall be equipped with a stop ring to prevent the service line from protruding into the main. The wall thickness of the saddle at the line through the branch at the saddle's longest point shall be 0.250" and shall taper to 0.125" at its thinnest edge. A tolerance of +0.010" shall be acceptable. The saddle shall have a minimum skirt length of 14". The saddle shall be of one-piece design and shall fit the exact roundness of the pipe.

- 409.17.4 The saddle shall have a centering ring on the outlet side of the saddle at a thickness of 0.200". The surface shall be smooth without sharp edges. The socket depth shall conform to ASTM 3033-85 and ASTM 3034-85 specification with Schedule 40 dimensions O.D. The Schedule 40 outlet hub shall be equipped with an adapter to accept cast iron soil pipe. The saddles shall be GPK solvent skirt, or equal. The saddles shall be cemented to the liner, using an expanding polyurethane foam, 3M

Scotch-Seal 5600, or equal. The saddle shall be strapped to the liner, using stainless steel bands.

409.17.5 Any saddle meeting the above referenced specifications and the requirements for materials, per table 702.3 Building Sewer Pipe and table 702.4 Pipe Fittings of the International Plumbing Code (IPC) 1997, or equal shall be acceptable.

409.17.6 The service connection riser shall be carried from the main to the existing elevation of the connection, utilizing bell and spigot cast iron soil pipe. At a location approved by the ENGINEER, a connection between the existing lateral service and the new service shall be made, utilizing a solid sleeve coupling, Rockwell Omni, OCUT sewer connector, or approved equal.

409.17.7 Prior to backfilling where the existing sewer has been broken open, the CONTRACTOR shall fill the annular space between the sliplining pipe and the existing sewer pipe with polyurethane foam, 3M Scotch-Seal 5600, or equal, for a distance of at least 6" either side of the service tap. The intent of this polyurethane foam is to seal the sewer line so that nothing can enter or exit the sewer system at the service tap, nor can fluids flow between the existing sewer pipe and the liner past the service tap.

409.17.8 All existing service laterals shall be reconnected without reducing the diameter of the service. Reconnecting a 6" service line to a 7.125" O.D. polyethylene slipline pipe shall utilize a 7.125" O.D. x 6" SDR-35 Gasketed saddle, as manufactured by GPK or equal.

409.18 BACKFILL

409.18.1 At all points where the polyethylene pipe has been exposed (such as at the insertion shafts, at the service connection fittings, or other points where the old pipe must be removed), the polyethylene pipe and fittings shall be encased in concrete as specified by ENGINEER to prevent deflection due to earth loading or subsidence.

409.18.2 After all the encasement material is in place and accepted by Engineer, backfill shall be placed and compacted to required finishing grade in accordance with Part 402 RESTORATION and 403 BACKFILL.

409.19 FINAL ACCEPTANCE

409.19.1 After installation of the liner, CONTRACTOR shall TV inspect, in color, the sewer lines as specified and perform the following test on the sewer line.

409.19.2 TESTING: After installation and before any service connections are reinstated, CONTRACTOR shall run a test on the sewer line to determine if it is watertight.

409.19.3 CONTRACTOR shall furnish all necessary equipment to conduct the test. An acceptable method is a low-pressure air test, conducted as follows:

A) Pressurize the test section to 4.0 psi and hold above 3.5 psi for not less than two minutes. Add air if necessary, to keep the pressure above 3.5 psi. At the end of

this two-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.

- B) When the prevailing groundwater is above the sewer being tested, test pressure shall be increased 0.43 psi for each foot that the water table is above the invert of the sewer.

Sewer Size (Inches)	Minimum Test Time (Minutes)
8	4.00
10	5.00
12	6.00
15	7-1/2
18	9.00
21	10-1/2

- C) 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.
- D) If building sewers have been reinstated before the air test, they shall be considered part of the pipe to which they are connected, and no adjustment of the test time shall be allowed.
- E) CONTRACTOR shall supply the pressure gauge used and have minimum divisions of 0.10 psi and shall have an accuracy of 0.004 psi.

409.19.4 PAYMENT for air pressure tests, including the furnishing and installing of all equipment and materials, conducting the pressure test, and making all necessary repairs shall be considered as subsidiary to pipeline rehabilitation.

409.20 CLEANUP

409.20.1 After the installation work has been completed and all testing acceptable, CONTRACTOR shall clean up the entire project area and return the ground cover to grade. CONTRACTOR shall dispose of all excess material and debris not incorporated into the permanent installation.

409.21 MEASUREMENT AND PAYMENT

409.21.1 Sliplining shall be paid for at the Contract Unit Prices as follows: The unit price shall cover the entire cost of sewer lining, measured to the nearest 0.1', center of manhole to center of manhole, less 1/2 the diameter of both the upstream and downstream manholes.

409.21.2 Obstruction Removal shall be paid for at the bid unit prices for obstruction removal.

- 409.21.3 Payment for service connections shall be paid at the unit bid price for service connection.
- 409.21.4 The prices shall be payment in full for performing and completing the work and for furnishing all labor and materials necessary including excavation and removal of existing structure, trench safety system, pipe lining materials, pipe sealing materials, labor, backfilling, surface restoration, sodding, pavement replacement, sidewalk and driveway replacement, curb and gutter replacement, all testing, and all incidental costs.

PART 410 – CURED-IN-PLACE PIPE

410.1 DESCRIPTION

410.1.1 It is the intent of this specification to provide for the reconstruction of existing sewer lines by forming a new pipe within an existing deteriorated pipe, which has generally maintained its original shape. The Cured-In-Place Pipe (CIPP) shall provide flow capacity equal to or greater than 100% of the original pipe's flow capacity when considering age and condition. The process is defined as the reconstruction of sewer lines by installation of a thermosetting resin impregnated flexible felt fiber tube coated on one side with polyethylene or polyurethane, which is installed into the existing sewer line utilizing a water column or cool pressurized air. Curing is accomplished by circulating hot water or steam throughout the length of the inverted tube to cure the thermosetting resin into a hard, impermeable pipe with the polyethylene/polyurethane coating on the interior surface of the new pipe. The pipe shall extend the full length of the original pipe and shall provide a structurally sound, jointless, close fitting and corrosion resistant cured-in-place pipe. A Pulled-In-Place method of installation shall be allowed for pipe diameter sizes 6", 8", 10", and 12" only.

410.2 REFERENCE SPECIFICATIONS

410.2.1 Installation and material tests of Cured-In-Place Pipe (CIPP) must meet the minimum requirements demonstrated in the following ASTM standards:

410.2.2 ASTM F1743 Standard Practice for Rehabilitation of Existing Pipelines and Conduits by Pulled-In-Place Installation of Cured-In-Place Thermosetting Resin Pipe (CIPP)

410.2.3 ASTM F1216 Standard Practice for the Installation of Cured-In-place Pipe by Inversion Lining

410.2.4 ASTM D638 Test Method for Tensile Properties of Plastics (for pressure pipes only)

Tensile Stress	3,000 psi
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ASTM D790 Test Method of Flexural Properties of Plastics

Flexural Stress	4,500 psi
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Flexural Modulus	250,000 psi
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410.2.5 ASTM D-790 Test Method of Flexural Properties of Plastics

Flexural Stress	4,500 psi
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Flexural Modulus	250,000 psi
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410.2.6 ASTM D5813 (Cured-In-Place Thermosetting Resin Sewer Pipe)

410.2.7 ASTM D2990 (Tensile, Compressive, and Flexural Creep and Creep-Rupture of Plastics)

410.3 SUBMITTALS

- 410.3.1 Product Data: Resin, Tube material, qualification testing results for laminate sample, resin enhancer, bond enhancer, certification of applicability of resin; sealant/caulking material, resin curing schedule showing time and temperature for each reach, manufacturer's recommended installation, pressures, minimum and maximum reach, and manufacturer's wet out report.
- 410.3.2 Design Information: Wall thickness design calculations are required for each pipe section.
- 410.3.3 Inspection Information: Video recordings (DVD/external drive) of pre- and post-inspections.
- 410.3.4 Full-length temperature sensing system to be utilized for all pipe sizes of 24" and larger.
- 410.3.5 Qualifications: Documentation for experience of lining manufacturer and installer.
- 410.3.6 Certificate: Installer Certification by the Manufacturer and a Certificate of Compliance that the tube meets all relevant specifications and ASTM Standards shall be required.
- 410.3.7 Public Relations: Notification Fliers or Door Hangers.

410.4 QUALIFICATIONS

Since sewer products are intended to have a 50-year design life, and in order to minimize the Owner's risk, only proven products with substantial successful long-term track records will be approved.

Products and Installers seeking approval must meet all the following criteria to be deemed Commercially Acceptable:

- 410.4.1 For a product to be considered Commercially Proven, a minimum of 1,000,000 LF of successful CIPP wastewater collection system installations shall be performed in the U.S. and documented to the satisfaction of the Owner to assure commercial viability.
- 410.4.2 For an Installing Company to be considered as Commercially Proven, the Installer must satisfy all insurance, financial, and bonding requirements of the Owner, and must have had at least 5 (five) years active experience in the commercial installation. In addition, the Installer must have successfully installed at least 100,000 feet of a cured-in-place product in wastewater collection systems in the U.S. for host pipe diameters equal to or larger than that which is intended for this project. Acceptable documentation of these minimum installations must be submitted to the Owner. Installer's project manager assigned to this project must

have minimum of 5 years of CIPP installation experience with the exact product and Installing Company intended for use with this bid.

410.4.3 Sewer rehabilitation products submitted for approval must provide third party test results supporting the structural performance (short-term and long-term) of the product and such data shall be satisfactory to the Owner. No product will be approved without independent third-party testing verification.

410.4.4 Both the rehabilitation manufacturing and installation processes shall operate under a quality management system which is third-party certified to ISO 9000 or other recognized organization standards. Proof of certification shall be required for approval.

410.5 MATERIALS

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

410.5.2 Resin – The resin system shall be a corrosion resistant polyester or vinyl ester system including all required catalysts, initiators that when cured within the tube create a composite that satisfies the requirements of ASTM F1216, ASTM D5813, and ASTM F1743, the physical properties of herein, and those which are to be utilized in the submitted and approved design of the CIPP for this project. The resin shall produce a CIPP that will comply with the structural and chemical resistance requirements of this specification.

410.5.3 The minimum length shall be that deemed necessary by the Engineer to effectively span the pipelining distance of the necessary manhole section unless otherwise specified. The line lengths shall be verified in the field before impregnation of the tube with resin.

410.5.4 The outside of the tube, before installation, shall have an impermeable polyethylene or polyurethane plastic coating. This coating will form the inner layer of the finished pipe and is required for enhancement of corrosion resistance, flow, and abrasion properties. CIPP interior lines colors shall be white or a relatively light reflective color so that a clear detailed examination with closed circuit television inspection equipment may be made.

410.5.5 End Seal – A compression gasket sealing product that swells with the presence of water shall be utilized at the junction of the main and manhole. The end seal is a molded rubbered gasket that provides a full-circle compression seal to a substantial

area at the end of a mainline pipe that is rehabilitated by lining. The end seal shall be Insignia™ Hydrophilic End Seal as manufactured by LMK Technologies or engineer approved equivalent.

410.5.6 Caulking/Sealant – Sealant shall be a quick-set epoxy mortar or high viscosity epoxy with good adhesion to the line and original pipe material.

410.5.7 The Owner authorizes the use of proven materials that serve to enhance the pipe performance specified herein. Proven materials have passed independent laboratory testing, not excluding long-term (10,000 hour) structural behavior testing and have been successfully installed to repair the failing host pipes in the U.S. for at least 5 years. In addition to the aforementioned requirement, the owner may require that the contractor demonstrate that the enhancements proposed exceed the specifications herein, prior to the installation of the enhanced material systems. This section in no way shall be interpreted as authorization to deviate from the minimum standard practices set forth herein.

410.6 FULL-LENGTH TEMPERATURE MONITORING

410.6.1 System shall consist of a wire probe with sensors no more than ten (10) feet apart running the length of the pipe section to be lined and a computer with vendor software for monitoring in real time and recording curing data. Data output will consist of a report indicating the time and temperature at each sensor location. System shall have the ability to monitor the curing from a remote location, and this ability will be made available to the Owner and Engineer. The Owner and Engineer will be provided training in how to access the site for remote viewing and an overview of the system. Temperature monitoring systems will be the ZIA Systems, Vericure by Pipeline Renewal Technologies, or approved equal.

410.7 DESIGN

410.7.1 General Requirements of Cured-In-Place Pipe (CIPP) – The finished pipe must be such that when the thermosetting resin cures, the total wall thickness will be a homogenous and monolithic felt and resin composite matrix that will be chemically resistant to withstand internal exposure to domestic sewage. When cured, the CIPP shall be a tight fit liner to the host pipe.

410.7.2 The CIPP shall be designed to a minimum wall thickness based on the individual project parameters and the condition of the existing conduit. The pipe design shall have sufficient strength to support all dead loads, live loads and groundwater loads imposed.

410.7.3 The cured lining material shall conform to the minimum structural standards, as listed below.

Linear Material Test Cured Liner	Standard	Results
Tensile Stress	ASTM D638	3,000 psi
Flexural Stress	ASTM D790	4,500 psi
Flexural Modulus	ASTM D790	400,000 psi

Design Parameters: (unless otherwise noted in the Drawings)

Design Condition: Fully deteriorated	Safety Factor = 2.0
Ground water = ½ soil depth	Ovality = 2.0%
Long Term flexural modulus = 50% of short term (75% for enhanced materials with testing validation)	Live Load H2) = 16,000 lbs.
Soil modulus = 700 psi for depth < 10' and 1000 psi for depth > or = to 10'	Soil Density = 120 pcf
	Poisson's Ratio = 0.3
	Enhancement factor K = 7

- 410.7.4 Independent material tests for compliance with this specification shall be made according to the applicable ASTM standards. Upon request, a certificate of compliance will be provided for all materials furnished under this specification.
- 410.7.5 The contractor shall submit his price proposal based on the appropriate length, size and existing pipe parameters designated in the Bid Item or Bid Proposal Section. The deterioration of sewers is an on-going process. Should pre-construction inspections reveal the sewers to be in substantially different conditions than those in the design considerations, the contractor shall request such changes in reconstruction liner thickness, supporting such requests with design data. The deviation, if approved, shall be reflected by Change Order.
- 410.7.6 The Manufacturer must have performed long-term testing for flexural creep of the resin. Such testing results are to be used to determine the long-term, time dependent flexural modulus to be utilized in the product design. A percentage of the instantaneous flexural modulus value (as measured by ASTM D790 testing) will be used in design calculations for external buckling. The percentage, or the long-term creep retention value utilized, will be verified by this testing. Retention values exceeding 50% of the short-term test results shall not be applied unless substantiated by qualified third party test data to the Owner's satisfaction. The resin and materials utilized for the contracted project shall be of equal to or better than the materials used in the long-term test with respect to the initial flexural modulus used in the CIPP design.
- 410.7.7 The layers of the cured CIP shall be uniformly bonded. It shall not be possible to separate any two layers with a probe or point of a knife blade so that the layers separate cleanly or the probe or knife blade moves freely between the layers. If the layers separate during field sample testing, the CIPP shall be repaired or replaced by the Contractor at their expense.

410.8 PRE-INSTALLATION PROCEDURES

410.8.1 The following installation procedures shall be adhered to unless otherwise approved by Engineer.

410.9 SAFETY

410.9.1 CONTRACTOR shall carry out his operations in strict accordance with all OSHA and manufacturer's safety requirements. Particular attention is drawn to those safety requirements involving working with scaffolding and engineering confined spaces.

410.10 INSPECTION

410.10.1 Additional internal inspection as noted on drawings shall be conducted by CONTRACTOR prior to actual construction. Inspection shall be accomplished by means of closed-circuit color television. Supplemental normal cleaning (3 passes of jet nozzle) of the pipes to allow a clear and unobstructed view of the pipe walls will be the responsibility of CONTRACTOR and is considered as incidental to the work.

410.11 CLEANING OF SEWER LINES

410.11.1 Prior to any lining of a pipe so designated, it shall be the responsibility of CONTRACTOR to remove all internal debris out of the sewer lines in accordance with Section III, "Sewer Line Cleaning" NASSCO Specifications for Sewer Collection System Rehabilitation.

410.11.2 Sewers shall be cleaned of all debris, roots and other materials that would block proper inversion of the Cured-In-Place Pipe. Utilizing high-pressure jet cleaning equipment, several passes shall be completed to assure that all debris is removed from the pipe. If roots are present, root cutters or mechanical brushes shall be attached to the jet nozzle and sent through the line to remove all root intrusions. Heavy cleaning (beyond normal) shall either be performed by Owner or shall be paid by separate pay item.

410.11.3 Owner or Engineer shall approve cleaning prior to liner insertion.

410.12 TELEVISION INSPECTION

Sewers shall be CCTV inspected providing both a video recording and written log identifying all service connections and openings. Utilizing a color video inspection system with data recording capabilities, the entire pipe sections shall be recorded on standard transfer media to become the property of the City.

Identification and Pre-measurement of Lateral Connections. A 360-degree Pan-and-Tilt view camera shall be used to inspect the pipe traveling upstream. At each connection, the operator will stop and turn the camera lens toward the lateral thereby inspecting the first 8" to 12" of the lateral connection. If there remains a doubt as to whether or not the connection is live, additional "Dye and Flush" tests shall be performed. It will be the responsibility of the Engineer to review this process live or review the video to verify and approve which lateral connections are to be

reinstated. All lateral locations will be measured from the back wall (opposing wall) of the basis manhole, typically, the downstream manhole.

Inspection of Pipelines – Inspection of pipelines should be performed by experienced personnel trained in locating breaks, obstacles, and service connections by closed-circuit television or man entry. The interior of the pipeline should be carefully inspected to determine the location of any conditions that may prevent proper installation of the impregnated tube, such as protruding service taps, collapsed or crushed pipe, and reductions in the cross-sectional area of more than 10%. These conditions should be noted so that they can be corrected. A pre-insertion video shall be prepared by the Contractor.

410.13 LINE OBSTRUCTION

- 410.13.1 The original pipeline should be clear of obstructions such as solids, dropped joints, protruding service connections, crushed or collapsed pipe, and reductions in the cross-sectional area of more than 10% that will prevent the insertion of the resin-impregnated tube. Protruding service connections shall be removed to prevent dimpling of the finished liner unless approved by the Owner or Engineer. Maximum allowable protrusion shall be 1/2".
- 410.13.2 The Contractor shall perform all obstruction removals for the sewer section scheduled for relining. The repair shall be an adequate repair for insertion of the resin-impregnated tube. This shall be paid at the bid price for obstruction removal.
- 410.13.3 If the Contractor identifies obstructions that cannot be removed by conventional sewer cleaning equipment, then, with the Engineer's approval, an excavation shall be made to remove the obstruction.
- 410.13.4 If pre-insertion inspection reveals a condition such as a protruding service connection, dropped joint, or a collapse that will prevent the insertion process or will result in an unacceptable installation, and it cannot be removed by conventional sewer cleaning equipment, defined as high-pressure jetters, root cutter or grinders, then Contractor shall consult with the Engineer before proceeding with the appropriate remedy. If condition resulting in extra effort by the Contractor was not shown on the drawing or revealed to the Contractor at the time of the bid, the work shall be considered as a separate pay item by Changer Order.

410.14 INFILTRATION

- 410.14.1 Minor infiltration is a normal condition sometimes encountered during the CIPP process. It is not a "changed condition" and should not be regarded as a reason for change orders. If in the opinion of the Engineer, infiltration is significant enough to adversely affect the curing process, chemical grouting or other remedies may be required. This additional work will be paid for by the Owner as a Change Order.

410.15 SITE RESTORATION

410.15.1 Areas damaged or modified by the Work for his project shall be repaired or restored to a condition equal to or better than the original condition. Site restoration is incidental to the Work and shall not be regarded as a reason for change orders.

410.16 PUBLIC RELATIONS

410.16.1 A Public Information and Notification Program shall, as a minimum, require the Contractor to be responsible for contacting homeowners or businesses who will be affected by the construction activities and informing them of the work to be done and the estimated timing for the work. Written notice shall be delivered to each home or business two (2) weeks prior to installation. Notice shall include a local telephone number of the Contractor they can call to discuss the project, and how the homeowner or business will be affected. The written notice must be reviewed by the Owner or Engineer prior to the start of any work.

A follow-up notice shall be delivered to each home or business connected to the sanitary sewer two (2) days prior to installation. The notice shall instruct occupants to minimize water usage the day of the insertion and fill all drain traps with water to prevent potential odors.

410.17 BY-PASS OF FLOW AND INTERRUPTION OF SERVICE

410.17.1 Contractor, when required, shall provide for the flow of sewage around the section or sections of pipe that are to be lined. The bypass shall be made by plugging the line at an existing upstream manhole and pumping the flow into a downstream manhole or adjacent system. The pump and bypass lines shall be of adequate capacity and size to handle anticipated wet weather flow or peak flow.

410.17.2 All procedures for maintaining flows must meet the approval of the Owner or Engineer. Contractor shall submit a detailed plan of all methods of flow management, in advance of flow interruption.

410.18 INSTALLATION OF LINES

410.18.1 Prior to installation of the liner, the full-length temperature sensing system shall be placed and tested to ensure proper functioning. If more than two sensors in a row or more than 10% of the total sensors are malfunctioning, the entire sensor array shall be replaced and retested. Time and temperature shall be monitored in accordance with manufacturer's recommendations.

410.18.2 Resin Impregnation of the CIPP Tube – The Contractor shall designate a location where the tube shall be impregnated or "wet out" with resin, using distribution rollers and a "single-source" vacuum system to thoroughly saturate the tube's felt fiber prior to installation in the field. The impregnated tube shall be free of pinholes, resin voids, and other defects. If the Cured-In-Place Pipe is impregnated at the manufacturing plant, it shall be delivered to the job site in a refrigerated truck and remain refrigerated prior to installation to prevent premature curing.

- 410.18.3 The tube should be vacuum impregnated with resin (wet out) under controlled conditions. The volume of resin used should be sufficient to fill all voids in the tube material at nominal thickness and diameter. The volume should be adjusted by adding 5% to 10% excess resin per the manufacturer's recommendation for the change in resin volume due to polymerization and to allow for any migration of resin into the cracks and joints in the original pipe.
- 410.18.4 Inversion of CIPP Tube – The resin impregnated tube shall be water inverted or cool air pressure-inverted through an existing manhole or other approved access point until it has fully traversed the designated line length and the inversion face breaches the destination manhole or termination point. Thermocouples shall be placed at the top and, if possible, at the bottom interface of both ends of the liner for monitoring temperature during the cure cycle. A “Pulled-In-Place” method of installation shall be allowed for pipe diameter sizes 6”, 8”, 10”, and 12”.
- 410.18.5 CIPP Processing (Curing and Cool Down) – the cure cycle and cool down will be dictated with consideration given to actual field conditions and shall be according to the manufacturer's recommendations. The curing temperatures shall be monitored at the heater truck's water inlet and outlet lines. The temperature readings from the truck will be compared to the thermocouples to ensure that sufficient heat is being supplied to the system to effect proper cure. Once the pipe has been cured, cool water shall be slowly introduced into the rehabilitated pipe. The water temperature shall be cooled inside of the pipe at a rate of 20° to 30° per hour until the water temperature is within 20° of the ambient temperature. The cool down process will also be affected by actual field conditions and may be modified in cases of severe conditions or below normal ground temperatures. Contractor shall not discharge cooling water to storm sewer system.
- 410.18.6 Termination and Sealing at Manhole Outlets – Termination of the Cured-In-Place Pipe at the manhole is completed by trimming the inverted pipe end back within approximately 6” of the outlet.
- 410.18.6.1 **An end seal per the materials specification shall be installed at the termination of CIPP at the manhole inlets & outlets.** All roots deposits, and debris should be removed from the pipe with hydraulically powered equipment, high velocity jet cleaners, or mechanically powered equipment as per NASSCO recommended specifications prior to installation of CIPP with end seals. Since the Insignia End Seal product may be used with a variety of rehabilitative pipe liners, the standard installation practices of each individual pipe liner method should be closely followed.
- 410.18.7 Hydraulic Capacity – overall, the hydraulic profile shall be maintained as large as possible. The CIPP shall have a minimum of the full flow capacity of the original pipe before rehabilitation. Calculated capacities may be derived using a commonly accepted roughness coefficient for the existing pipe material, taking into consideration its age and condition. The roughness coefficient of the CIPP shall be verified by third party test data and certified by a letter from manufacturer or raw material supplier.

410.19 SERVICE CONNECTIONS

- 410.19.1 After the liner has been cured Contractor shall reconnect the service connections. All service connections to existing buildings are to be reconnected, except where disconnection is approved by the Engineer. Service connection to a vacated lot shall not be reconnected. If more than one service is found per lot then, the Contractor shall verify that service connections are active by introducing dye into the lines at cleanouts, vent stacks or other access points as approved by the Engineer. Dye testing shall be recorded by CCTV inspection at the location in the main line where the dye appears. All addresses will be noted on log sheets for future reference. Provide the address of all reconnected and disconnected services.
- 410.19.2 It is the intent of the City that all service reconnections be made by external service reconnection in accordance with 410.19.4. Where there is no protruding pipe, cracks, or leaks, or where significant surface obstructions exist, service connections shall be internally reinstated as directed by Engineer in accordance with 410.19.3 or 410.19.4. Internal reinstatement of services alone will not be permitted.
- 410.19.3 Internal Reconnection: **Internal service reconnections without an internal tee-liner or top hat type liner shall not be allowed without prior written approval by the Owner.** Without excavation, the service connection shall be reinstated by means of a television camera and a cutting device that re-establishes the connection to not less than 90% capacity. Service connections shall be cut in with neat and smooth circumferential lines to prevent snagging of debris and/or solids. Contractor shall provide a physical demonstration, in the presence of the Engineer, to show the assurance of a watertight seal of all service connections. Service interruptions to any homes tributary to the sewer line being rehabilitated shall not exceed 24 hours. **Internal service reconnections shall require submittal to Engineer and include internal tee-liner and/or top hat type reconnection.**
- 410.19.4 External Reconnection: Service connections shall be reinstated by excavation and reconnecting the service with an approved saddle or engineer approved equivalent. The Contractor shall remove the appropriate amount of carrier pipe to allow the saddle to be directly connected to the outside wall of the CIPP. An epoxy, meeting the manufacturer's recommendations, shall be applied to the saddle to assure a watertight seal between the saddle and CIPP or host pipe. The saddle shall be secured with stainless steel bands. After the epoxy has set and prior to backfilling, the Contractor shall seal any open annular space between the existing sewer and new liner pipe with a non-shrink grout. The Contractor shall then completely encase the saddle and exposed pipe in concrete. Care shall be used not to damage the CIPP. If damage occurs as a result of the Contractor's operations, the Contractor shall assume all cost associated with the repair of the CIPP.
- 410.19.5 Connections of the saddle fitting to the existing lateral shall be made using elastomeric boots, full-encirclement clamps, or by other method as approved by the Engineer.

410.20 FINAL INSPECTION AND ACCEPTANCE

- 410.20.1 Upon completion of the installation, the rehabilitated sewer shall be CCTV inspected providing both a video recording and log identifying all service connections and openings. The entire pipe section rehabilitated shall be recorded on standard transfer media with the video becoming the property of the City.
- 410.20.2 CIPP samples shall be prepared and physical properties tested in accordance with ASTM F1216, Section 8.1, using either method proposed. The flexural modulus must meet or exceed the value used in design in Section D (structural requirements for the pipe size and thickness furnished in design.)
- 410.20.3 Leakage testing of the CIPP shall be accomplished during curing while under a positive head. CIPP products in which the pipe wall is cured while not in direct contact with the pressurizing fluid (e.g., a removable bladder) must be tested by an alternative method approved by the Engineer.
- 410.20.4 Visual inspection of the CIPP shall be in accordance with ASTM F1216, Section 8.6.
- 410.20.5 Upon acceptance of the installation work and testing, the Contractor shall restore the project area affected by the operations to a condition at least equal to that existing prior to the work.
- 410.20.6 After installation of the liner, Contractor shall TV inspect the sewer line as specified herein and perform the following test on the sewer line.
- 410.20.7 Post-insertion video recording TV log in a format acceptable to the Engineer shall be provided to the Engineer within two (2) weeks of taping. With the exception of sag locations in existing host pipe, the pipe must be dry and clean during the televising. Camera speed shall not exceed two feet per second. Video quality shall be high.
- 410.20.8 No wrinkles, or other defects, will be allowed that, in the opinion of the Owner or Engineer, will impede flow.
- 410.20.9 Cured Pipe Physical Properties: Samples of the cured pipe should have the minimum physical properties (flexural stress, modulus of elasticity, and thickness) recommended herein.

410.21 MEASUREMENT AND PAYMENT

- 410.21.1 Cured-In-Place Pipe shall be paid for at the Contract Unit Prices as follows: The unit price shall cover the entire cost of sewer lining, measured to the nearest 0.1', center of manhole to center of manhole, and include any by-pass pumping, dye, and flush testing, and all acceptance testing.
- 410.21.2 Obstruction Removal shall be paid for at the set unit prices of each for obstruction removal. Where point repairs are specified, they shall be installed and paid for in accordance with Part 412 of the City of Tulsa Standard Specifications and Standard Details.

- 410.21.3 Payment for external service connections shall be paid at the unit bid prices for service connections. No additional payment shall be paid for internal service connections reinstatement unless a tee-liner or similar is specified and installed. Tee-liner or top-hat style internal liners shall be paid for by separate pay item different from external service reconnections.
- 410.21.4 Television pre-inspection shall be paid for at the unit price bid per linear foot of pipeline to be inspected. The unit price bid for Television Pre-inspection shall be payment in full for all materials, labor, and equipment necessary for televising the pipe prior to repairing or rehabilitating it. The linear feet paid shall be as measured from center of the upstream manhole to the center of the downstream manhole. Payment shall only be made once for any manhole-to-manhole pipe segment; no additional payment shall be made for multiple inspections of the same pipe segment. Payment will not be made until the pre-inspection video has been approved.
- 410.21.5 The cost of normal cleaning will not be paid for separately but shall be included in the Contract Unit Price of the rehabilitation or replacement being performed.
- 410.21.6 The cost of heavy cleaning shall be paid for at the unit price bid per linear foot of pipeline to be cleaned. The unit price bid for Heavy Cleaning shall payment in full for all materials, labor, cost of material disposal, and equipment necessary for heavy cleaning of the pipe prior to repairing or rehabilitating it.
- 410.21.7 The cost of post construction television inspection will not be paid for separately but shall be included in the Contract Unit Price of the rehabilitation or replacement being performed. This shall include all costs associated with the television inspection, such as viewing, record logs, and standard transfer media.
- 410.21.8 The prices shall be payment in full for performing and completing the work and for furnishing all labor and materials necessary including excavation and removal of existing structure, trench safety system, pipe lining materials, pipe sealing materials, labor, backfilling, surface restoration, sodding, pavement replacement, sidewalk and driveway replacement, curb and gutter replacement, all testing, and all incidental costs.

END OF SECTION

PART 411 – PIPELINE PRESSURE GROUTING

411.1 SEWER LINE CLEANING

411.1.1 **GENERAL.** All sludge, dirt, rocks, bricks, grease, roots, and other debris shall be cleaned from each section requiring grouting by one of the following appropriate methods:

- A) **Light Deposits.** If color television inspection reveals that only small deposits of debris are present within the segment, cleaning shall be accomplished by using high pressure water jetting equipment.
- B) **Heavy Deposits.** If color television inspection reveals that large deposits of debris or root growth are present within the segment, cleaning shall be accomplished by using bucket machines, high pressure water jetting equipment, scrapers, augers, and root cutters.
- C) **Roots.** Visible evidence of roots from the television inspection shall be noted by CONTRACTOR. All roots shall be mechanically and chemically removed prior to grouting. CONTRACTOR shall apply chemical root eradicant in a manner that will result in a root-free barrier around the outer perimeter of the pipe joint to be grouted. Root eradication plan shall be approved by ENGINEER.
- D) All debris from the cleaning operation shall be removed at the downstream manhole and disposed of at an approved landfill or dump site.
- E) Any damage to the sewer line or joints caused by cleaning equipment shall be repaired at no expense to City.

411.2 JOINT TESTING AND SEALING

411.2.1 **EQUIPMENT: Testing Equipment.** The basic equipment used shall consist of a color television camera, joint testing device and test monitoring equipment. The equipment shall be constructed in such a way as to provide means for introducing the test medium, under pressure, into the void area created by the expanded ends of the joint-testing device and means for continuously measuring the actual static pressure of the test medium at and within the void area only.

411.2.2 Void pressure data shall be transmitted electrically from the void to the monitoring equipment, i.e. via a TV picture of a pressure transducer located at the void. A mixing manifold packer will be required.

411.2.3 All test monitoring shall be above ground and in a location to allow for simultaneous and continuous observation of the television monitor and test monitoring equipment by ENGINEER.

411.3 MATERIALS

- 411.3.1 The Contractor shall be thoroughly trained and familiar with handling, mixing, and placing all material. All materials shall be used in strict accordance with manufacturer's recommendations and with the provisions of all OSHA and other safety regulations. Field conditions must be appropriate for and compatible with component mixing for the linings and sealants. All materials shall conform to and be installed according to manufacturer's recommendations and specifications. Contractor shall supply all necessary materials, including storage and transportation to the satisfaction of Engineer. Materials damaged by Contractor shall be replaced at no additional cost to the City. Existing manhole frames and covers being replaced shall become the property of City.
- 411.3.2 CHEMICAL GROUTING SYSTEMS: Where the pressurized injection of chemical grout is required, the material supplied shall be a urethane gel or a urethane foam (the material supplied shall be 3M Scotch-Seal 5600 (foam), or 3M Scotch-Seal 5610 (gel), without exception) with properties as follows:
- 411.3.3 General: Chemical sealing materials for use in manhole rehabilitation shall have the following properties and characteristics:
- A) While being injected, the chemical sealant must be able to react/perform in the presence of infiltrating water.
 - B) The cured sealant must be capable of withstanding submergence in water without degradation.
 - C) The cured sealant must prevent the passage of water through the manhole defect.
 - D) The cured sealant must be flexible as opposed to brittle or rigid.
 - E) In place, the cured sealant shall be able to withstand freeze/thaw and wet/dry cycles without adversely affecting the seal.
 - F) The cured sealant must not be biodegradable. Additives may be used to meet this requirement, without affecting long-term strength.
 - G) The cured sealant shall be chemically stable and resistant to concentrations of acids, alkalis, and organics found in normal sewage.
 - H) Packaging of component materials must be compatible with field storage and handling requirements. Packaging must provide for worker safety and minimize spillage during handling.
 - I) In the event that the chemical sealant may be harmful by passing through the unbroken skin, by inhalation of dust, vapor or mist, or by swallowing, the handling and mixing shall be performed with proper equipment and by personnel thoroughly familiar with the chemicals involved and shall be in strict accordance with the manufacturer's recommendations and with the provisions of all safety regulations.

- J) Mixing of component materials must be compatible with field conditions.
- K) Residual sealing materials must be easily removable from the bench of manhole to prevent reduction or blockage of the sewer flow.
- L) No grouting operations shall be performed at temperatures below 40° F or where the temperature of the groundwater is below 40° F.

411.3.4 Urethane Gel: Urethane gel shall have the following properties and characteristics:

- A) One-part urethane prepolymer thoroughly mixed with between five and ten parts water by weight. The recommended mix ratio is one-part urethane prepolymer to eight parts of water (11% prepolymer).
- B) A liquid prepolymer having a solids content by weight of 77% to 83%, specific gravity of 1.04 (8.65 pounds per gallon), and flash point of 200° F.
- C) A liquid prepolymer having a viscosity of 600 to 1,200 centipoise at 70, that can be pumped through 500' of 1/2" hose with a 1,000-psi head at a one-ounce per second flow rate.
- D) The water used to react the prepolymer should be in the pH range of 6.5 to 8.0.
- E) A cure time of 80 seconds at 40° F, 55 seconds at 60° F, and 30 seconds at 80° F when one-part prepolymer is reacted with eight parts of water only. Higher water ratios give longer cure times.
- F) A cure time that can be reduced to ten seconds for water temperatures of 40° F to 80° F when one-part prepolymer is reacted with eight parts water containing gel control agent.
- G) A relative rapid viscosity increase of the prepolymer/water mix. Viscosity increases from about 10 to 60 centipoise in the first minute for 1:8 prepolymer/water ratio at 50° F.
- H) A reaction (curing) which produces a chemically stable, non-biodegradable, tough, flexible gel.
- I) The ability to increase mix viscosity, density, gel strength and resistance to shrinkage by using additives in the water component of the grout.
- J) The ability to accept suspended additives such as 2,6-dichlorobenzonitrile root control.
- K) Contain a minimum of 15% shrink control agent supplied by the same manufacturer.

411.3.5 Urethane Foam: Urethane foam shall have the following properties and characteristics:

- A) Approximately one-part of urethane prepolymer thoroughly mixed with one-part water by weight (50% prepolymer).
- B) A liquid prepolymer having a solids content by weight of 82% to 88%, specific gravity of 1.1 (9-15 pounds per gallon), and flash point of 200° F.
- C) A liquid prepolymer having a viscosity of 30 to 500 centipoise at 72° F that can be pumped through 500' of 1/2" hose with a 500-psi head at a one-ounce/second flow rate.
- D) 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.
- E) A cure time of 5.5 minutes at 40° F, 3.5 minutes at 70° F, and 2.6 minutes at 100° F when the prepolymer is reacted with water containing 0.4% accelerator.
- F) During injection, foaming, expansion, and viscosity increase takes place.
- G) Physical properties of the cured foam of approximately 14 pounds per cubic foot density, 80 to 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.
- H) The ability to accept suspended additives such as 2,6-dichlorobenzonitrile for root control.

411.4 EXECUTION

411.4.1 Test Medium. Air only is acceptable.

411.4.2 Test Procedure. Each sewer pipe joint which is not visibly leaking shall be individually tested at a pressure equal to 0.5 psi per vertical foot of pipe depth (not exceeding a test pressure of 6 psi and not less than 3.5 psi) in accordance with the following procedures:

- A) The testing device shall be positioned within the line in such a manner as to straddle the pipe joint to be tested.
- B) The testing device ends (end elements, sleeves) shall be expanded so as to isolate the joint from the remainder of the line and create a void area between the testing device and the pipe joint. The ends of the testing device shall be expanded against the pipe with sufficient pressure to contain a minimum of 6 psi within the void without leakage past the expanded ends.
- C) The test medium shall then be introduced into the void area until a pressure equal to or greater than the required test pressure is observed with the void pressure monitoring equipment. If the required test pressure cannot be developed, the joint

will have failed the test and shall be sealed as specified in Part 411.4.3 "Joint Sealing Procedure".

D) After the void pressure is observed to be equal to or greater than the required test pressure, the air flow shall be stopped. If the void pressure decreases by more than 2 psi within 15 seconds, the joint will have failed the test and shall be sealed as specified in Part 411.4.3 "Joint Sealing Procedure".

411.4.3 Joint Sealing Procedure. Joint sealing shall be accomplished by injecting chemical grout into or through faulty joints by a system of pumps, hoses, and sealing packers. The packer shall be a hollow type packer to allow for flow of wastewater during the sealing operation. The packer shall be positioned over the faulty joint by means of a measuring device and the closed-circuit television camera in the line. The procedure used by CONTRACTOR for positioning the packer shall be accurate to avoid overpulling the packer and thus not effectively sealing the intended joint. The packer ends shall be expanded using controlled pressure. The expanded ends shall seal against the inside periphery of the pipe so as to form a void area at the faulty joint thereby isolating from the remainder of the pipeline. 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. Pumps, fittings, and hoses shall be designed to transport a high viscosity material and shall be capable of supplying an uninterrupted and continuous flow of the sealing material at rates between 0.25 and 10 gallons per minutes at a minimum pressure of 60 psi, for a continuous period of up to ten minutes.

411.5 JOINT SEALING VERIFICATION

411.5.1 TESTING. Upon completing the sealing of pipeline joint, all loose and residual sealing material shall be removed from the interior of the pipe. The sealed joints shall be left "flush" with the existing surface. All joints sealed shall then be tested as described in Part 411.4.2 "Test Procedure" and those joints which fail to meet the specified test criteria shall be resealed and retested until the test criteria can be met in order to receive payment.

411.5.2 TELEVISION INSPECTION OF GROUTING. CONTRACTOR shall furnish a video color recorder to record the entire grouting operation. The video shall be available for review by ENGINEER at all times. At the completion of line grouting operations, all videos shall become the property of City.

411.5.3 RECORDS: CONTRACTOR shall supply to ENGINEER complete records of all lines grouted. These records shall include, but not be limited to, the following: joint testing, joint sealing quantity of grout used at each joint, the number of injections required to seal each joint, and TV videos with audio and visual accounts of the testing and sealing operation on each joint. The date, line segment, footage, and pressure tests accurate to 0.1 psig shall be indicated in digital format on the screen.

411.6 MEASUREMENT AND PAYMENT

- 411.6.1 Pipeline Pressure Grouting shall be paid for at the Contract Unit Prices as follows: The unit price shall cover the entire cost of sewer pipeline grouting, measured to the nearest 0.1', center of manhole to center of manhole, less 1/2 the diameter of both the upstream and downstream manholes.
- 411.6.2 The prices shall be payment in full for performing and completing the work and for furnishing all labor and materials necessary including excavation and removal of existing structure, trench safety system, pipe grouting materials, labor, backfilling, surface restoration, all testing, labor and all incidental costs.

PART 412 – POINT REPAIRS

412.1 GENERAL

- 412.1.1 **INTENT:** Point repairs are work required to repair defective sections of existing sewer lines. Repair work may be required at joints, service connections, and to short segments of damaged pipe by removal and replacement of sections of pipe. All work to expose and correct the defects, and the materials and methods used shall conform to the applicable specifications, including excavation and backfill, surface restoration, pipe installation, and sewer flow control. A point repair is considered to be 10' in length. Repair footage required greater than 10' is considered extra length.
- 412.1.2 **TELEVISION INSPECTION:** CONTRACTOR shall clean and inspect each line immediately prior to reconstruction utilizing a pan and tilt camera capable of verifying active or inactive service connections and the overall structural condition of the pipeline. All roots, debris, and protruding service connections shall be removed prior to reconstruction. Inspection shall include the complete length of the line from manhole to manhole. The exact location of the point repairs will be determined by internal television inspection prior to excavation. The Standard Transfer Media will have a digital footage display on the screen and shall be reviewed by ENGINEER prior to excavation to determine the extent of the repair as indicated on the Drawings.
- 412.1.3 **NOTIFICATION:** CONTRACTOR shall notify ENGINEER not less than 48 hours in advance of the time he plans to begin repair work at a particular location with the Project.

412.2 MATERIALS

- 412.2.1 **PIPE AND FITTINGS:** All pipeline point repair materials shall be like-kind, in accordance with Parts 305, 306, 307, and 313.
- 412.2.2 **BACKFILL:** Backfill, including pipe bedding, shall be placed and compacted as specified in Part 302.
- 412.2.3 **RIGID FITTINGS:** Pipeline point repairs shall be connected to solid existing pipe with rigid fittings with stainless steel fittings, clamps and bands, Dresser fittings or approved equal.

412.3 PROCEDURE

- 412.3.1 Excavate repair pit and uncover the sewer line a minimum of 12" clearance all around the damaged section.
- 412.3.2 Remove defective pipe or fittings to the nearest joint or by cutting perpendicular to the pipe axis to leave a plain end.
- 412.3.3 Prepare a replacement section of like pipe material, or as otherwise approved by ENGINEER, to within 1/4" of required replacement pipe length.

- 412.3.4 Connect replacement section to existing pipe with appropriate size rigid coupling.
- 412.3.5 All service connections within the repair area shall be tested by CONTRACTOR to determine if they are active or inactive. Only active services shall be reconnected to the sewer system. Inactive services shall be plugged with hydraulic cement or non-shrink grout. Any liability associated with the plugging of active services shall be the CONTRACTOR'S sole responsibility.
- 412.3.6 Service connections shall be reinstated with an approved saddle. The saddle shall be secured with stainless steel bands. The connection to the existing lateral shall be made with using a solid sleeve coupling, Rockwell Omni, OCUT sewer connector, or approved equal. Where a service lateral reconnection cannot be made because of the poor condition of the existing service lateral pipe, the ENGINEER must be notified. Additional work may then be authorized.
- 412.3.7 Point repairs shall be visually inspected and measured by ENGINEER prior to backfilling.
- 412.3.8 Surface Restoration: Service and lateral pits, and other work areas shall be restored to condition as good as that before construction occurred. Disturbed grasses shall be sodded in accordance with Part 402 Restoration. Pavements removed or damaged shall be replaced. Concrete embankment shall be replaced or installed at locations indicated in the Drawings and in accordance with these specifications.

412.4 TESTING

- 412.4.1 PROCEDURE: Sanitary sewer lines with point repairs shall be tested to determine the adequacy of each repair by televising the repaired area and 10' beyond each end of the repair. Video media of the repaired section shall be provided for ENGINEER and shall become property of City.
- 412.4.2 Visual observations, by ENGINEER, may be made where repairs can be observed by lamping the sewer line from the closest manhole, instead of television inspection. If the repair is found to be unsatisfactory by ENGINEER, CONTRACTOR shall repair the defect at no additional cost.
- 412.4.3 TESTING CRITERIA: A repair will be considered unsatisfactory if any one of the following are observed:
 - A) Pipe joint not seated properly.
 - B) Improperly connected lateral or service connection.
 - C) Cracked or broken pipe.

412.5 MEASUREMENT AND PAYMENT

- 412.5.1 Pipeline Point Repairs shall be paid for at the Contract Unit Prices as follows: The unit price shall cover the entire cost of a 10' sewer repair.
- 412.5.2 Additional length of repair required will be paid for at the unit price bid for additional horizontal feet of repair, paid to the nearest 0.1'.
- 412.5.3 The prices shall be payment in full for performing and completing the work and for furnishing all labor and materials necessary including excavation and removal of existing structure, trench safety system, pipe repair materials, connectors, pipe sealing materials, labor, backfilling, surface restoration, testing, and all incidental costs.
- 412.5.4 Service reconnections within the point repair area shall be included with the unit price bid for point repairs.

PART 413 – CONCRETE EMBANKMENT

413.1 GENERAL

- 413.1.1 This work shall consist of the construction of riprap composed of approved stone, grouted stone, or reinforced concrete, in accordance with these specifications and as shown on the Drawings or as established by the Engineer.

413.2 MATERIALS

- 413.2.1 Reinforced Concrete riprap shall be Class A concrete. Stone riprap shall be in accordance with Part 214 of the City Specifications.

413.3 EXECUTION

- 413.3.1 Excavation. The area upon which the riprap is to be placed shall be excavated to the required grades and lines and the surface shall be smoothed and compacted. Sheeting shall be used for forming the toe wall for concrete riprap, if necessary, in order for the concrete to be placed in the dry.

413.3.2 Reinforced Concrete Riprap.

- A) Reinforced concrete riprap shall be of Class A concrete. Sufficient temporary headers and strike-offs shall be used to construct the riprap to the dimensions and grades indicated and to obtain a smooth, even surface. The surface shall be finished with a wooden float and lightly broomed to obtain a more desirable finish.
- B) Reinforcement shall be placed as indicated on the Drawings. Unless otherwise noted on the Drawings, the reinforcement shall extend through construction joints.
- C) Contraction joints shall be spaced as indicated on the Drawings and shall be constructed by inserting a metal plate in the fresh concrete or by cutting the fresh concrete with a trowel or other suitable tool. The indentations shall extend to the reinforcement and be perpendicular to the surface of the riprap. Guide plates shall be used in making the indentations to insure straight joints.
- D) Curing for Concrete Riprap. The curing of concrete riprap shall begin immediately after finishing, and curing shall continue for at least seven days.
- E) Curing shall be accomplished and maintained so that moisture is always present at the concrete surface and shall be an integral part of the concreting operations.
- F) Concrete surfaces shall be covered with wet burlap, moisture proofed burlap, liquid membrane-forming compound, white polyethylene sheeting or other approved impermeable material immediately after the finishing of the concrete has been complete and at such time that marring of the concrete will not occur. If any curing material becomes perforated or torn, it shall be immediately repaired or discarded.

and replaced with acceptable material. The Contractor shall furnish a work bridge for application of curing materials.

- G) If rain falls on the newly coated concrete before the film has dried sufficiently to resist damage, or if the film is damaged in any other manner, a new coat of the membrane shall be applied to the affected portion equal in curing value to the original application.
- H) Spraying equipment shall be capable of supplying a constant and uniform pressure to provide uniform and adequate distribution of the curing membrane at the rates required. The curing membrane shall be continuously agitated during application.
- I) When concrete is being placed and the ambient air temperature may be expected to drop below 40° F. during the curing period, the contractor shall provide suitable measures such as straw, additional burlap, or other suitable blanketing materials and/or housing and artificial heat to maintain the concrete temperature between 40° F and 90° F as measured on the surface of the concrete. The surface of the concrete shall be kept moist by the use of an approved moisture barrier such as wet burlap or polyethylene sheeting. The moisture barrier shall be maintained in intimate contact with the concrete during the entire seven-day curing period. After the completion of the required seven-day curing period, the Contractor shall remove the curing and protection in such a manner that rapid cooling of the concrete will be prevented.

413.3.3 Stone Riprap

- A) The stones for riprap shall be laid on edge with the bedding plane at right angles to the slope with the ends and sides abutting. The larger spaces between stones shall be filled with spalls of suitable size and all spalls shall be rammed thoroughly in place. The entire surface shall be rammed and compacted to obtain a tight surface. The finished surface shall present an even surface conforming to the lines, grades, and sections given.
- B) When grouted stone riprap is indicated, the spaces between stones of grouted riprap shall be filled with grout consisting of one-part Portland cement and three parts of fine aggregate with sufficient water to form a plastic mix. The grout shall be poured and broomed into the spaces until they are completely filled.
- C) The grout shall be cured in the manner provided above for concrete riprap.

413.4 MEASUREMENT AND PAYMENT

- 413.4.1 This work shall be measured by the square yard of riprap complete in place as measured along the finished surface. The amount of completed and accepted work, measured as provided above, shall be paid for at the Contract unit price per square yard for riprap of the type designated complete in place, which prices shall be full compensation for furnishing, transporting, delivering and placing all materials, for all

excavation, and for all labor, equipment, tools, and incidentals necessary to complete the work.

PART 414 – CLAY DAM

414.1 EXECUTION

- 414.1.1 Clay Dam construction shall be performed in accordance with the Wastewater Clay Dam construction detail at the locations indicated on the Drawings. Clay Dams shall be keyed into undisturbed soil to make an impervious barrier to reduce groundwater percolation through the pipeline trench. Construction material shall consist of compacted bentonite clay or quickset flowable fill.
- 414.1.2 Clay Dam construction shall include performing and completing the work and furnishing all labor and materials necessary including excavation and removal of existing structure and materials, trench safety system, clay dam materials, forming, placing and finishing, labor, backfilling, surface restoration, all testing, labor and all incidental costs.

414.2 MEASUREMENT AND PAYMENT

- 414.2.1 Payment for Clay Dam construction shall be included with other construction and shall not be paid for separately.
- 414.2.2 The prices shall be payment in full for performing and completing the work and for furnishing all labor and materials necessary including excavation and removal of existing structure and materials, trench safety system, clay dam materials, labor, backfilling, surface restoration, all testing, and all incidental costs.

PART 415 – CONSTRUCTION TELEVISION INSPECTION OF SANITARY SEWER

415.1 GENERAL

415.1.1 PRE-CONSTRUCTION TELEVISION INSPECTION shall include an internal television inspection of the pipeline prior to performing pipe reaming (406), pipe crushing (407), pipe bursting (408), sliplining (409), Cured-In-Place Pipe (CIPP) (410), pipeline pressure grouting (411), and point repairs (412).

415.1.2 POST CONSTRUCTION TELEVISION INSPECTION covers the furnishing of all necessary materials and equipment to perform television inspection of all sanitary sewer lines and point repairs installed under this contract. Television inspection is considered as a part of the final inspection. A satisfactory inspection is required before the project is considered complete.

415.2 MATERIALS

415.2.1 Standard format video recording equipment and standard transfer media are required for video recordings. The video camera used for the inspection shall be specifically designed and constructed for such inspection and shall provide a color picture. Lighting for the camera shall be suitable to allow a clear picture of the entire periphery of the pipe acceptable to the Engineer. The camera shall be operative in 100% humidity conditions and shall have a minimum of 600-line resolution.

415.2.2 Recording equipment shall be equipped with data recorder capable of the following:

A) Date and time

B) Footage

C) Project name, Contract number, Contractor, and inspection firm

D) Location and manhole number

415.3 EXECUTION

415.3.1 The Contractor shall obtain the services of a qualified independent company to perform the television inspection.

415.3.2 The Contractor shall provide traffic control during inspection operation to maintain public traffic and safety of all personnel.

415.3.3 The Contractor shall clean and clear all obstructions, roots, debris, sand, and gravel from the sewer to be inspected.

415.3.4 Satisfactory precautions shall be taken to protect the sewer lines from damage that might be inflicted by the improper use of inspection equipment. Any damage done

during inspection shall be repaired by the Contractor. There shall be no additional payment for these repairs.

415.3.5 Internal Television Inspection

- A) The inspection shall be done one sewer section at a time. The section being inspected shall be isolated from the remainder of the sewer in a manner approved by the Engineer. Any defects found shall be repaired by the Contractor and then re-inspected. There shall be no additional compensation allowed for such repair or re-inspection.
- B) The camera shall be moved through the line in either direction at a uniformly slow rate, stopping at all defects to allow adequate evaluation by the Engineer. In addition, the camera shall be stopped at each service connection.
- C) Cost for excavation to retrieve inspection equipment shall be the responsibility of the Contractor. The City shall not be liable for any costs relative to retrieving inspection equipment from the sewer system.
- D) Sanitary sewer mains must be laced with enough water to fill all low points. The television inspection must be done immediately following the lacing of the main with no water flow. Sanitary sewage may be used to propel the camera if the main is live. However, flow may be restricted in a manner approved by the Engineer when necessary to provide a clear image of the sewer being inspected.
- E) Telephones, portable radios, CB, walkie talkies, or other electronic means of voice communication must be set up where voice or manual communication is not feasible.
- F) Pre-construction television inspection shall include verification of active service connections by introducing dye into the lines at cleanouts, vent stacks or other access points as allowed by the private property owner. Dye testing shall be recorded by CCTV inspection at the location in the main line where the dye appears. All addresses will be noted on log sheets for future references. Post construction television inspection shall identify the address of each service reconnected.

415.3.6 Viewing

- A) The television inspection company shall provide facilities for the purpose of viewing the monitor while the inspection is in progress.
- B) The Engineer shall witness the television inspection.

415.3.7 Record Logs

- A) The video of each sewer segment shall note on the standard transfer media the project name and number, the beginning manhole number, the ending manhole

number, the time, and date of inspection. Footage for camera location in the sewer line shall be displayed continuously during the inspections.

- B) The original unaltered video recordings will be reviewed by the Engineer for focus, lighting, clarity of view, and technical quality. The inspection company shall maintain sharp focus, proper lighting, and clear, distortion-free viewing during the camera operations. Failure to maintain these conditions can result in rejection of the video by the Engineer. Any sewer line whose video is not acceptable to the Engineer shall be re-televised at no expense to the City.
- C) Defects shall be described and quantified on the videos by the company doing the inspection. Measurement for location of defects in sewer mains shall be at the ground level by means of a metering device. Marking on cable of the like which requires interpolation for depth of manhole will not be allowed. Measurement meters shall be accurate to 0.2'. Measurements shall be taken from the center of the manhole and displayed on the video.
- D) A typewritten report shall be provided with the video. Each run sheet shall identify the segment being televised, and the location of each service or defect with its appropriate clock position.
- E) Each month, the Contractor shall provide to the City the original video and logs of each section of sewer line televised.

415.4 MEASUREMENT AND PAYMENT

- 415.4.1 Television pre-inspection shall be paid for at the unit price bid per linear foot of pipeline to be inspected. The unit price bid for television pre-inspection shall be payment in full for all materials, labor, and equipment necessary for televising the pipe prior to repairing or rehabilitating it. The linear feet paid shall be as measured from the center of the upstream manhole to the center of the downstream manhole. Payment shall only be made once for any manhole-to-manhole pipe segment; no additional payment shall be made for multiple inspections of the same pipe segment. Payment will not be made until the pre-inspection video has been approved.
- 415.4.2 Obstruction Removal shall be paid for at the bid unit price for obstruction removal.
- 415.4.3 The cost of post construction television inspection will not be paid for separately but shall be included in the Contract Unit Price of the rehabilitation or replacement being performed. This shall include all costs associated with internal television inspection, such as viewing, record logs, and standard transfer media.

PART 416 – COMPLETE MANHOLE REPLACEMENT

416.1 SCOPE

- 416.1.1 Work covered in this section consists of complete manhole replacement. Testing, cleanup, and materials requirements are also included.
- 416.1.2 The Contractor shall be responsible for the furnishing of all labor, supervision, materials, and equipment required to complete all rehabilitation and replacement work and testing in accordance with the Contract Documents. This includes any follow-up rehabilitation work required of the CONTRACTOR by the ENGINEER.

416.2 MATERIALS

- 416.2.1 The Contractor shall be thoroughly trained and familiar with handling, mixing, and placing all material. All materials shall be used in strict accordance with manufacturer's recommendations and with the provisions of all OSHA and other safety regulations. Field conditions must be appropriate for and compatible with component mixing for the linings and sealants. All materials shall conform to and be installed according to manufacturer's recommendations and specifications and shall conform to City Standard Specifications unless herein modified. Contractor shall supply all necessary materials, including storage and transportation to the satisfaction of Engineer. Materials damaged by Contractor shall be replaced at no additional cost to the City. Existing manhole frames and covers being replaced shall become the property of City. Contractor shall dispose of existing castings at a site indicated by Sewer Operations and Maintenance.
- 416.2.2 Precast concrete manholes will be allowed for complete manhole replacements.
- 416.2.3 Frames and covers shall be as specified in Part 418 – Replacement of Manhole Frame and Cover, Frame Seal, Chimney, and Grade Adjustment.
- 416.2.4 Exterior surfaces of manhole sections shall be coated only when specified. Coating shall be two mop coats of coal tar epoxy paint, Koppers "Bitumastic Super Service Black", Tnemec "46-450 Heavy Tnemecol", or approved equal. Dry film thickness shall be a minimum of 14.0 mils per coat. Recoating shall be done in accordance with manufacturer's recommendations. Interior coatings shall be required in accordance with Part 211.1.8.
- 416.2.5 Grout shall be non-shrink in the plastic state and show no expansion after set as tested in accordance with ASTM C827 and shall develop compressive strength not less than 3,000 psi with a trowelable mix within 24 hours per ASTM C109. The placement time shall be not less than 45 minutes based on initial set per ASTM C191. Test results shall be furnished by the manufacturer and submitted to the ENGINEER.
- 416.2.6 Opening for each connecting pipe shall be circular with a compression type flexible rubber gasket cast integrally into the manhole wall. Flexible gaskets shall be manufactured in accordance with rubber joint specification ASTM C443 and shall meet

the performance and test requirements of ASTM C425 for compression joints. Pipe seals to the new manhole structure shall be A-Lok, Presswedge, or approved equal.

416.3 REPLACE COMPLETE MANHOLE

- 416.3.1 Complete manhole replacement shall be done in accordance with the Drawings and as shown in the Standard Specifications. Any structurally unsound manholes observed by Contractor shall be replaced as directed by ENGINEER.
- 416.3.2 The existing manhole structure designated for complete replacement shall be completely removed before installation of the new precast manhole structure. Contractor shall dispose of all debris and prevent any debris from entering the existing sewer lines.
- 416.3.3 Manhole diameters shall be 4' I.D. for 8" to 12" pipe; 5' I.D. for 15" to 21" pipe; and 6' I.D. for 24" to 36" pipe. For pipes larger than 36" diameter, a special manhole is required.
- 416.3.4 All new manholes shall have 30" frame and covers in accordance with the Standard Details
- 416.3.5 Install frames and covers in accordance with Part 418 – Replacement of Manhole Frame and Cover, Frame Seal, Chimney, and Grade Adjustment. Precast manhole sections shall be sealed and wrapped in accordance with construction details.
- 416.3.6 Any damage done to existing sanitary pipe during excavation or replacement shall be replaced by Contractor at no additional cost.
- 416.3.7 Contractor shall maintain wastewater flow at all times. Contractor shall submit a plan for maintaining wastewater flow to the ENGINEER prior to beginning work.
- 416.3.8 Form inverts with mortar material and steel-trowel to produce a dense, smooth finish and shape to form a channel that approximates the lower half of the inside diameter of the pipe. The channel shall extend to 3/4 the diameter of the pipe. Bench shall be shaped to drop approximately 2" from wall to invert.
- 416.3.9 Any incoming pipes which are 2' or more above the outgoing invert elevation shall be equipped with outside drop connections.
- 416.3.10 Complete manhole replacement shall also include replacement of frame and cover, bench and invert, frame seal, grade adjustment and five linear feet of pipe at each connection to the manhole. Pipe shall be like kind unless otherwise ordered by the ENGINEER. Additional footage of pipe, if required, will be paid for at a per foot price as shown in the bidding documents.
- 416.3.11 Service lines encountered shall be connected to the main sewer outside the manhole using an integral tee connection.

- 416.3.12 A concrete collar shall be constructed on each manhole constructed or repaired in pavement in accordance with the Drawings. Concrete collars shall not be constructed in unpaved areas. Concrete collars constructed in asphalt streets shall be constructed to finish grade with concrete. No additional payment will be made for concrete collars as the concrete collar is considered subsidiary to other items of work.
- 416.3.13 The exterior surface of all chimneys, frame adjustments and pre-cast manhole sections joints shall be thoroughly cleaned with a wire brush and then waterproofed with a minimum 3/8" coat of trowelable bitumastic joint sealant (Easystik, Tnemec Series 265 Elasto-Shield TG, or approved equal) up to and including the bottom flange of the frame. The entire frame and grade adjustment shall then be wrapped with six mil plastic to protect against damage from backfill.
- 416.3.14 Complete manhole replacement includes performing and completing the work and for furnishing all labor and materials necessary including excavation and removal of existing structure, trench safety system, replacement of frame and cover, installing new adjustment rings, manhole walls, manhole steps, corbel and/or flattops, bench/invert and base for complete manholes, pipe replacement required at each pipe entering the manhole, backfilling, surface restoration, and all testing.

416.4 MEASUREMENT AND PAYMENT

- 416.4.1 Complete manhole replacement shall be paid for at the Contract Unit Prices as follows:
- A) A unit price to cover the construction of one standard manhole of the diameter and type indicated; 0' to 6' in depth.
 - B) A unit price which shall cover the entire cost of each additional foot of vertical manhole depth in excess of 6', measured to the nearest 0.1'.
- 416.4.2 The prices shall be payment in full for performing and completing the work and for furnishing all labor and materials necessary including excavation and removal of existing structure, trench safety system, replacement of frame and cover, installing new adjustment rings, manhole walls, corbel and/or flattops, bench/invert and base for complete manholes, five linear feet of pipe replacement at each pipe entering the manhole including rigid connection, backfilling, surface restoration all interior and exterior coatings, and all testing.
- 416.4.3 Additional pipe required for Manhole Replacement may be required when the 5' length of pipe included in the Manhole replacement is inadequate to reach to sound pipe. If additional pipe is required, restoration bid items will be paid for, including Sodding, Pavement Replacement, Sidewalk and Driveway Replacement and Curb and Gutter Replacement at the unit price per bid item.

PART 417 – REPLACEMENT OF CLEANOUT / LAMPHOLE AND/OR CLEANOUT / LAMPHOLE FRAME AND COVER

417.1 GENERAL

407.1.1 Description: This section describes replacement of existing lamphole frame/cover, the sealing of cleanout frames and the complete cleanout/lamphole replacement. At the Engineer's direction, cleanouts/lampholes where location permits, and the work area is not restricted may be replaced and paid for with a manhole in accordance with Part 416 – COMPLETE MANHOLE REPLACEMENT.

417.2 MATERIALS

417.2.1 The replacement cover shall form a water-resistant seal between the frame and lamphole cover surface. The cover shall have a concealed pick bar, and a machined bearing surface between cover and frame.

417.2.2 A typical standard lamphole frame/cover design shall conform to the City of Tulsa Standard Detail 360.

417.2.3 Covers shall set flush with the rim of the frame and shall have no larger than a 1/8" gap between the frame and lid.

417.2.4 Bearing surfaces shall be machine finished.

417.2.5 Portland Cement Concrete shall be specified in Part 402 – RESTORATION.

417.2.6 The joint between frame ring and chimney and between the frame ring and PVC shall be sealed with trowelable bitumastic joint sealer material. The bitumastic joint sealer shall meet or exceed Federal Specifications SS-S-210A. The trowelable sealer shall be as manufactured by Easystik, or approved equal, and applied in strict accordance with the manufacturer's specifications and recommendations. The material shall be able to withstand hydrogen sulfide and other corrosive gases found in sewers.

417.2.7 Cleanout/lamphole riser section shall be constructed using DIP or PVC pipe as directed by the Engineer.

417.2.8 Backfill shall be in accordance with Part 403 – BACKFILL.

417.3 EXECUTION

417.3.1 The Contractor shall be responsible for supplying the required material for the replacement of the frame and/or covers, and sealing of frame including the unloading, temporary storage, and transporting of the materials.

417.3.2 To replace frame and cover only, the work consists of removal of existing lamphole frame and base, and replacement with a new frame, cover, and concrete base, in

accordance with the detail and specification. Excavation will be required for replacement or extension of pipe.

417.3.3 Frames shall be sealed to the base with bitumastic joint sealer. Base and frames shall be free of dirt, stones, debris, and voids to ensure a watertight seal. Wire brush frame and exposed base to remove dirt and loose debris. Coat exposed base surface with an approved bonding agent, Weld-Crete as manufactured by Larsen Products Company or approved equal, followed with an application of a quick-setting hydraulic cement to provide a smooth working surface as thin as possible. Place the flexible bitumastic joint material, minimum 1/2" thick, in two concentric rings along the inside and outside edge of the joint.

417.3.4 Lamphole rims in parkways, lawns, and other improved lands shall be at an elevation not more than 1" nor less than 1/2" above the surrounding ground. Backfill shall provide a uniform slope from the top of casting for not less than 3' each direction to existing finish grade of the ground. The grade of all surfaces shall be checked for proper slope and grade by string lining the entire area regraded near the manhole.

417.3.5 Lamphole riser stacks which may be damaged during removal of the existing lamphole, shall be replaced at the Contractor's expense by using a like material and jointing to existing undamaged pipe using a rubber coupling with stainless steel bands.

417.3.6 Cleanout/lamphole diameters shall be 8".

417.3.7 Backfill shall be in accordance with Part 403 – BACKFILL.

417.3.8 Restoration shall be in accordance with Part 402 – RESTORATION.

417.3.9 Replacement shall include replacement of riser pipe, replacement of frame and cover, backfill and concrete, restoration and all other appurtenances related to the replacement.

417.3.10 Trench Safety shall be in accordance with applicable OSHA, State, and local regulations.

417.4 MEASUREMENT AND PAYMENT

417.4.1 To replace cleanout/lamphole cover and frame only, payment shall be based on the Contract Unit Price per each cleanout/lamphole frame and cover replacement. Payment will provide complete compensation for locating lamphole; excavation; removal and replacement of lamphole casting; concrete embedment (base); placing and compaction of backfill and restoration of surface features.

417.4.2 Cleanout/lamphole replacement shall be paid at the Contract Unit Price to cover the construction of one standard cleanout/lamphole for all depth. Unit price shall include all items necessary for complete replacement of cleanout/lamphole to include, but not be limited to, frame and cover replacement, concrete, riser pipe, concrete embedment

(base), placing and compaction of backfill and restoration of surface features, and all labor and materials required for complete replacement.

PART 418 – REPLACEMENT OF MANHOLE FRAME AND COVER, FRAME SEAL, CHIMNEY, AND GRADE ADJUSTMENT

418.1 SCOPE

418.1.1 Work covered in this section consists of replacement of manhole frame, cover, frame seal, chimney, and grade adjustment in accordance with this Section and with City of Tulsa Standard Detail 402. Testing, cleanup, and materials requirements are also included.

418.1.2 The Contractor shall be responsible for the furnishing of all labor, supervision, materials, and equipment required to complete all rehabilitation and replacement work and testing in accordance with the Contract Documents. This includes any follow-up rehabilitation work required of the Contractor by the ENGINEER.

418.2 MATERIALS

418.2.1 The Contractor shall be thoroughly trained and familiar with handling, mixing, and placing all material. All materials shall be used in strict accordance with manufacturer's recommendations and with the provisions of all OSHA and other safety regulations. Field conditions must be appropriate for and compatible with component mixing for the linings and sealants. All materials shall conform to and be installed according to manufacturer's recommendations and specifications. Contractor shall supply all necessary materials, including storage and transportation to the satisfaction of Engineer. Materials damaged by Contractor shall be replaced at no additional cost to the City. Existing manhole frames and covers being replaced shall become the property of City. Contractor shall dispose of existing castings at a site indicated by the Sewer Operations and Maintenance.

418.2.2 Frame Sealing Materials

A) The joint between frame ring and chimney and between the frame ring and top row of brick shall be sealed with trowelable bitumastic elastic material. The bitumastic joint sealer shall meet or exceed Federal Specifications SS-S-210A. The trowelable sealer shall be as manufactured by Easystik, or approved equal, and applied in strict accordance with the manufacturer's specifications and recommendations. The material shall be able to withstand hydrogen sulfide and other corrosive gases found in sewers.

B) Alternatively, for frame to manhole or riser ring to manhole, two rings of bitumastic rope of M1 adhesive may be used in lieu of trowelable bitumastic as approved by the Engineer.

C) Applied sealing material may not be permitted in certain applications where field conditions restrict its use as directed by the ENGINEER.

418.3 FRAME

- 418.3.1 Frame material shall be cast iron conforming to ASTM A48, Class 35B, or better. The frame shall exhibit a tensile strength of not less than 35,000 psi.
- 418.3.2 Frames for existing 4' I.D. Sanitary manholes, new 4' I.D. and larger Sanitary Manholes, or lampholes shall conform to Standard Details 352, 353, 354 or 360, as applicable, and Part 209 – Castings.
- 418.3.3 Bearing surfaces between the ring and cover shall be machine finished or ground to assure non-rocking fit in any position, and interchangeability.
- 418.3.4 Frames shall be certified by the manufacturer to meet AASHTO M 306-89 requirements.

418.4 COVER

- 418.4.1 The replacement cover shall form a water-resistant seal between the frame and manhole cover surface. The cover shall have pick bars or pick slots and a machined bearing surface on the bottom and side of the casting. The cover material shall be cast iron conforming to ASTM A48, Class 35B or better, for Gray Iron. The cover shall exhibit a tensile strength of not less than 35,000 psi.
- 418.4.2 A typical manhole cover design shall conform to Standard Details 353 and 354.
- 418.4.3 Covers shall set flush with the rim of the frame and shall have no larger than a 1/8" gap between the frame and cover.
- 418.4.4 Covers shall be certified by the manufacturer to meet AASHTO M 306-89 requirements.

418.5 CHIMNEY RISER RINGS

- 418.5 Precast concrete chimney riser rings shall be a minimum of 4" thick, shall conform to ASTM C478, and shall be one piece. For sloping surface grades tapered chimney rings may be used to permit the manhole frame and cover to conform to the sloping surface. No chimney ring will be allowed if the ring has a crack of more than 0.01" as measured by an appropriate gauge or measuring device. Concrete chimney riser rings shall not be used unless approved by the ENGINEER.
- 418.5.2 Plastic riser rings shall be manufactured by Cretex or approved equal.

418.6 WATERPROOFING MEMBRANE

- 418.6.1 A cold-applied seamless, elastomeric membrane shall be used for all partial and complete manhole rehabilitation. HLM 5000, as manufactured by Sonnenborn Building Products, shall be applied to the exterior of the exposed structure.

418.6.2 The membrane shall be a single component moisture curing bitumen modified polyurethane that is formulated for hand application by trowel to vertical surface. It shall comply with ASTM C836-84.

418.7 MATERIALS TESTING

418.7.1 Testing shall be the responsibility of the Contractor. Tests for compliance with this Specification shall be made as specified herein and in accordance with the applicable Specification. A Certificate of Compliance with this Specification along with a report of each test, shall be furnished by the Contractor for all material furnished under this specification. The Contractor shall inform the Engineer as to when, where, and by whom, testing will be conducted, at least one week prior to testing. The Engineer may, at its own expense, witness testing of the materials.

418.8 EXECUTION

418.8.1 Replacement of Cover/Frame/Frame Seal

418.8.2 Excavation and Pavement Replacement in Paved Areas:

- A) The removal of the manhole frame and cover shall be accomplished by making a circular cut in the pavement as shown in the Drawings.
- B) Material in the exposed area shall be excavated toward the casting to a depth of approximately 6" below the bottom of the frame. Excavated material shall be disposed of by Contractor.
- C) Specified sub-base materials shall be tamped in place to the minimum specified density as shown on the Drawings to form the sub-base for the pavement.
- D) Contractor shall, at no additional cost to the City, replace any portion of the existing manhole that is damaged during replacement of covers and frames.
- E) A concrete collar shall be constructed on each manhole constructed or repaired in pavement in accordance with the Drawings. Concrete collars shall not be constructed in unpaved areas. Concrete collars constructed in asphalt streets shall be constructed to finish grade with concrete. No additional payment will be made for concrete collars as the concrete collar is considered subsidiary to other items of work.
- F) At the City's option, all castings removed from the work and not reused shall remain the property of the City. Contractor shall stockpile castings at a location designated by the City. If the City elects not to retain ownership of the unused castings, the Contractor shall be responsible for their proper disposal. Disposal of other removed materials is also the Contractor's responsibility.
- G) The surfacing used to cover the exposed area shall conform to the existing pavement as specified in the Standard Specifications.

H) Pavement replacement not performed to the satisfaction of the ENGINEER shall be replaced by Contractor at no additional cost to City.

418.8.3 Excavation for Replacement in Unpaved Areas:

- A) No unnecessary excavation of materials from around the manhole shall be done.
- B) Backfill shall be replaced and compacted to prevent subsequent settlement and to restore the site to a condition equal to or better than that found. Backfill shall not cover the manhole.
- C) If surface obstructions are present that prevent access to the manhole, the obstructions shall be removed and reinstalled after completion of the work. Cost for this additional work is considered subsidiary to other items of work and will not be paid for directly.

418.8.4 Removal, Replacement, and Sealing of Manhole Frames:

- A) Replacement of chimney adjustment rings, and/or brick and mortar broken during excavation shall be at Contractor's expense. Damaged adjustments shall be replaced with plastic adjustment rings.
- B) The manhole frame shall be removed from the manhole and the condition of the grade adjustment rings shall be observed. Any damages shall be brought to the ENGINEER'S attention.
- C) All surfaces between the frame, chimney and corbel shall be free of dirt and debris. Joint sealing material shall be troweled concentrically on the grade to frame joint. If deterioration of the grade adjustments or chimney is observed, Contractor shall notify ENGINEER prior to replacement of the manhole frame, and partial chimney replacement may be required.
- D) Contractor shall, at no additional cost to the City, replace any portion of the existing manhole that is damaged during replacement of covers and frames.
- E) In paved areas frames shall be installed to the slope and finish elevation of the paved surface. The top of the frame shall be even with or 1/8" below the finished elevation. Allowances for the compression of the joint sealer material shall be made to assure a proper final grade elevation.
- F) Manhole frames in non-paved areas shall be installed at not more than 2" nor less than 1" above the surrounding surface. Site restoration shall provide a uniform slope away from the top of the manhole frame for a distance of not less than 3' in any direction.
- G) Manholes in drainage courses shall be at the elevation which existed prior to rehabilitation or as directed by ENGINEER.

H) A concrete collar shall be constructed on each manhole constructed or repaired in pavement in accordance with the Drawings. Concrete collars shall not be constructed in unpaved areas. Concrete collars constructed in asphalt streets shall be constructed to finish grade with concrete. No additional payment will be made for concrete collars as the concrete collar is considered subsidiary to other items of work.

418.9 REPLACEMENT OF CHIMNEY / GRADE ADJUSTMENT / FRAME SEALING

418.9.1 Excavation shall be to a minimum depth of 6" below the repair depth.

418.9.2 Chimneys being replaced shall use plastic riser rings as described in Section 418.5.2.

418.9.3 Contractor shall replace that portion of the defective manhole chimney up to a maximum depth of 24" below the bottom of the frame. If the chimney is deeper than 24", Contractor shall notify the Engineer prior to performing any work on the manhole. In those instances, the Contractor may be required to perform a Partial Manhole Replacement to include removal and replacement of the existing corbel or manhole barrel and either:

A) Replacement with a new manhole wall section and precast flattop section, or

B) Replacement with a new manhole wall section, corbel, frame, and cover.

418.9.4 A bonding agent, Weld-Crete as manufactured by Larsen Products Company or approved equal, shall be applied to the top surface of the existing manhole after the defective portion of the manhole has been removed. Hydraulic cement mortar shall be used to bring the surface to grade and provide a smooth surface for the joint sealing material and additional chimney riser rings. Thickness of hydraulic cement shall not exceed 3". Hydraulic cement shall be allowed to set a minimum of one hour prior to placement of joint sealing material and adjustment rings. Set time may be adjusted in accordance with the manufacturer's recommendations. The bonding agent and the cement mortar shall not be applied when the temperature is below manufacturer's recommendations.

418.9.5 All surfaces between the frame, chimney, and corbel shall be free of dirt and debris. Joint sealing material shall be placed at the edge of each chimney to frame joint, and top of corbel section.

418.9.6 Contractor shall, at no additional cost to City, replace any portion of the existing manhole that is damaged during chimney and frame sealing.

418.9.7 Grade adjustments exceeding 12", but less than 24", must be braced during backfilling operations. When the required grade adjustment exceeds 24", ENGINEER shall be notified prior to placement of new adjustment rings to determine if additional work is necessary.

418.9.8 The exterior surface of all chimneys and frame adjustments shall be thoroughly cleaned with a wire brush and then waterproofed with a minimum 1/2" coat of trowelable bitumastic joint sealant up to and including the bottom flange of the frame. The entire frame and grade adjustment shall then be wrapped with six mil plastic to protect against damage from backfill.

418.10 PARTIAL MANHOLE REPLACEMENT (TYPE F)

418.10.1 Overview: Partial manhole replacement shall be performed when required by the plans or as directed by the Engineer. Partial manhole replacement will be utilized when frame and cover replacements, chimney replacements, or grade adjustments cannot be performed within the allowable requirements of the City of Tulsa Specifications with regard to maximum height of the chimney section. Partial manhole replacement shall normally be required when a proposed grade adjustment would result in a chimney height of greater than 24". (See condition "A" in Standard No. 401.) Unless required by the plans, Partial Manhole Replacement shall not be performed unless directed by the Engineer.

418.10.2 Determination of need: Contractor shall bring to the Engineer's attention any manhole which, if adjusted to grade, would have a chimney height greater than 24". The Contractor and Engineer shall jointly inspect the manhole and reach agreement as to the work to be performed on the manhole. Should the Engineer require it, a partial manhole replacement shall be performed.

418.10.3 Execution: Partial manhole replacement shall consist of the removal of the existing manhole components necessary to expose the top barrel section of the manhole wall, to include the frame and cover, adjusting rings, and corbel; and replacement with additional manhole wall sections, corbel, adjusting rings, frame and cover as are necessary to achieve the proper manhole top elevation with a chimney height of less than 24".

418.10.4 The Contractor shall excavate the exterior of the manhole to an elevation 1' below the corbel/wall joint and shall remove the frame and cover, adjusting rings, corbel, and any portions of the wall which must be removed for the performance of the work. The exterior and top of the existing manhole wall shall be thoroughly cleaned of any dirt and debris; and any voids, joints, or irregularities shall be grouted.

418.10.5 The Contractor shall measure the diameter of the old manhole wall. In those instances where the old wall section is a precast section designed to utilize an O-ring gasket, and the new precast wall section or corbel will mate and seal over the old section, the installation will be completed in a manner consistent with the requirements for new construction (See Standard No. 358 and Section 314.7 of the Standard Specifications).

418.10.6 In those instances where the new and old wall sections have incompatible diameters, the Contractor shall complete the installation of the new wall/corbel section in accordance with Standard No. 401A. The Contractor shall utilize a new wall section or corbel with a diameter larger than the existing wall section. The Contractor shall saw cut the bottom edge of the new wall section or corbel to produce a flat, smooth surface.

Around the existing wall section, the Contractor shall pour a concrete collar upon which to set the new wall section or corbel. The top surface of the concrete collar and the bottom surface of the new wall section or corbel shall be prepared with hydrophilic paste and waterstop and the new wall section or corbel shall be placed upon the concrete collar. The exterior gap between the collar and new wall section or corbel shall be sealed with a non-shrink grout.

418.10.7 Prior to pouring of the concrete collar, a strip of hydrophilic paste shall be placed on the existing manhole wall to seal all joints, depressions, cavities, and irregularities in the surface. This shall be followed by placing a hydrophilic waterstop on the paste. The Cast-In-Place concrete collar shall be allowed to cure for 48 hours prior to installation of the new wall section or corbel. One strip of hydrophilic waterstop shall be placed on the new wall section or corbel prior to its installation on the concrete collar. Hydrophilic paste shall be ADEKA P101, or equal. Hydrophilic waterstop shall be ADEKA KBA-1510FP, or equal.

418.10.8 All new or old surfaces shall be primed with Weldcrete as manufactured by Larsen Products Company, or equal, prior to placement of concrete.

418.10.9 The exterior surfaces of all exposed existing wall sections, concrete collar, and new wall section, corbels, and adjusting rings shall be thoroughly cleaned with a wire brush and then waterproofed with a minimum 1/2" coat of troweable bitumastic joint sealant up to and including the bottom flange of the frame and then wrapped with a six mil sheet of plastic to protect against damage from backfill.

418.11 MEASUREMENT AND PAYMENT

418.11.1 Each item listed under this specification shall be measured and paid for at the unit price bid per manhole, regardless of size, for each manhole replaced or rehabilitated.

418.11.2 Measurement of Repair Types:

A) Replacement of manhole cover and frame and frame seal in accordance with Part 418.9.1 (Type A Repair) shall be paid for at the Contract Unit Price.

B) Replacement of manhole frame seal in accordance with Part 418.9.4 (Type B Repair) shall be paid for at the Contract Unit Price.

C) Replacement of manhole cover, frame, frame seal and chimney in accordance with Part 418.9.1 and 418.10 (Type C Repair) shall be paid for at the Contract Unit Price.

D) Replacement of manhole frame seal and chimney in accordance with Part 418.10 (Type D Repair) shall be paid for at the Contract Unit Price.

E) Payment for manhole grade adjustment shall be included in bid items for Repair Types A, B, C, D, or F in accordance with Part 418 of the Construction specification. No separate payment shall be made for manhole grade adjustment.

F) Partial Manhole Replacement in accordance with Part 418.11 (Type F) shall be paid for at the unit price bid for each of the following items:

- 1) Type Ft: Precast Flattop Section: The unit price bid for each precast flattop section shall be payment in full for performing and completing all work and furnishing labor, supervision, materials, equipment necessary to remove and dispose of the existing ring and cover, and install a new precast flattop section, complete with frame and cover upon an existing or new manhole wall section. No additional payment will be made for materials or installation or the new frame and cover. Additional payment will be made for a concrete collar (Type FI) and also for the vertical footage or precast wall section (Type Fw) needed to achieve the proper finished to elevation.
- 2) Type Fc: Precast Corbel Section: The unit price bid for each precast corbel shall be payment in full for performing and completing all the work, and furnishing labor, supervision, materials, equipment necessary to remove the existing frame and cover, corbel, or manhole wall section and replace it with a precast corbel of the required height; install adjusting rings, frame and cover; and all additional materials, equipment and labor needed for a complete restoration of the manhole. No additional payment shall be made for modifying portions of the existing manhole or the end section of the precast corbel to affect a watertight seal between the old and new manhole components or for adjusting rings, frame, and cover. Additional payment will be made for a concrete collar (Type FI). Additional payment will also be made for a precast wall section (Type Fw), if needed.
- 3) Type Fw: Precast Manhole Wall Section: The unit price bid for each vertical foot of precast manhole wall shall be payment in full for performing and completing all the work and furnishing labor, supervision, materials, equipment necessary to remove the existing corbel or section of manhole wall, and install each foot of new precast wall section up to the height required for the proposed installation. Payment for Precast Manhole Wall Section will be in addition to payment for a Precast Corbel Section if a new corbel is needed, or a new Precast Flattop Section if a new precast flattop section is needed. Additional payment will be made for a concrete Collar (Type FI).
- 4) Type FI: Cast-In-Place Concrete Collar: The unit price bid for each Cast-In-Place Concrete Collar shall be payment in full for performing and completing all the work, furnishing labor, supervision, materials, and equipment necessary to form and pour the concrete collar and install hydrophilic paste and waterstop, in preparation for installation of a Precast Corbel or Precast Wall Section, Cast-In-Place Concrete Collar shall only be paid for once for each manhole in which a Cast-In-Place Concrete Collar is installed.

418.11.3 The prices shall be payment in full for performing and completing the work and for furnishing all labor and materials necessary including excavation and removal of existing structure, replacement of frame and cover, chimney, frame sealing, grade adjustment, backfilling, surface restoration, and all testing. No payment shall be made

until the manhole and its adjacent area have been restored and the manhole and its appurtenances have satisfactorily passed testing.

PART 419 – PATCHING, REPAIRS, AND PLUGGING LIFT HOLES

419.1 SCOPE

- 419.1.1 Work covered in this section consists of rehabilitation of bench and invert, patching holes in the manhole, and plugging precast lift holes. Testing, cleanup, and materials requirements are also included. Steps shall not be removed from manholes requiring rehabilitation unless the steps are deemed unsound by the ENGINEER.
- 419.1.2 The Contractor shall be responsible for the furnishing of all labor, supervision, materials, and equipment required to complete all rehabilitation and replacement work and testing in accordance with the Contract Documents. This includes any follow-up rehabilitation work required of the Contractor by the ENGINEER.

419.2 MATERIALS

- 419.2.1 The Contractor shall be thoroughly trained and familiar with handling, mixing, and placing all material. All materials shall be used in strict accordance with manufacturer's recommendations and with the provisions of all OSHA and other safety regulations. Field conditions must be appropriate for and compatible with component mixing for the linings and sealants. All materials shall conform to and be installed according to manufacturer's recommendations and specifications. Contractor shall supply all necessary materials, including storage and transportation to the satisfaction of Engineer. Materials damaged by Contractor shall be replaced at no additional cost to the City. Existing manhole frames and covers being replaced shall become the property of City.

419.3 HYDRAULIC CEMENT

- 419.3.1 Hydraulic cement shall be used for repairing, filling, patching, and plugging various holes in manhole chimney, corbel, walls, bench, and invert. Hydraulic cement shall be durable, quick setting, high early strength hydraulic cement such as Pennygrout or Octocrete supplied by IPA or approved equal. Wall coating material may also be applied to the bench.

419.4 BENCH AND INVERT REHABILITATION (TYPE Gh)

- 419.4.1 Existing deteriorated bench and invert areas shall be removed to sound material. Care shall be taken to avoid damaging other parts of the manhole. Loose and broken brick and mortar shall be removed from the manhole to eliminate the possibility of pieces entering the sewer lines.
- 419.4.2 After removal of the existing deteriorated bench and invert areas, new bench and invert shall be formed in accordance with the Drawings. Bonding agent, Weld-Crete as manufactured by Larsen Products Company or approved equal, shall be applied to existing surfaces in accordance with manufacturer's recommendations. Octocrete or approved equal shall be placed in such a manner that it is consolidated, fills existing voids, and creates a smooth, dense, steel troweled surface in accordance with the

Drawings. Wastewater flow shall be maintained by methods which prevent contact with new bench and invert for 6-8 hours after concrete placement. If 6-8 hours set time is not possible, a fast setting, high early strength concrete shall be used with provisions for flow control until concrete has initially set. The bench and invert shall be finished in such a manner as to have a smooth surface and form a continuous monolithic conduit with the sewer pipe entering and leaving the manhole. The bench and invert shall form a watertight seal with the manhole walls, base and pipe seal and shall be cleaned of all debris or foreign matter.

419.4.3 Contractor shall, at no additional cost to City, replace any portion of the existing manhole which is damaged during bench and invert rehabilitation.

419.5 PLUG LIFT HOLES/PATCH HOLES (TYPE Go/TYPE Gr)

419.5.1 The lift hole or hole to be patched shall be cleaned and all loose debris removed. Holes shall have all unsolid material removed with hammer and chisel. Holes and voids shall be filled, and the patch consolidated to leave the repair location leak resistant. The surface shall be troweled to a smooth finish even with surrounding surfaces.

419.6 MEASUREMENT AND PAYMENT

419.6.1 Plug Lift Hole (Type Go): Lift Hole Plugging shall be paid at the unit price bid per manhole, regardless of the size of the manhole.

419.6.2 Patch Hole (Type Gr): Hole Patching shall be paid for at the unit price bid per manhole, regardless of the size or number of holes to be patched.

419.6.3 Bench and Invert Rehabilitation (Type Gh): Bench and Invert Rehabilitation shall be paid for at the unit price bid per manhole, regardless of the size, diameter, or material of the manhole or connected line segments.

PART 420 – MANHOLE STEP REMOVAL AND REPLACEMENT

420.1 SCOPE

- 420.1.1 Work covered in this section consists of removing steps in the manhole, patching holes, and replacing steps when specified. Testing, cleanup, and materials requirements are also included.
- 420.1.2 The Contractor shall be responsible for the furnishing of all labor, supervision, materials, and equipment required to complete all rehabilitation and replacement work and testing in accordance with the Contract Documents. This includes any follow-up rehabilitation work required of the Contractor by the ENGINEER.

420.2 MATERIALS

- 420.2.1 The Contractor shall be thoroughly trained and familiar with handling, mixing, and placing all material. All materials shall be used in strict accordance with manufacturer's recommendations and with the provisions of all OSHA and other safety regulations. Field conditions must be appropriate for and compatible with component mixing for the linings and sealants. All materials shall conform to and be installed according to manufacturer's recommendations and specifications. Contractor shall supply all necessary materials, including storage and transportation to the satisfaction of Engineer. Materials damaged by Contractor shall be replaced at no additional cost to the City.

420.3 HYDRAULIC CEMENT

- 420.3.1 Hydraulic cement shall be used for repairing, filling, patching, and plugging various holes in manhole chimney, corbel, walls, bench, and invert. Hydraulic cement shall be durable, quick setting, high early strength hydraulic cement such as Pennygrout or Octocrete supplied by IPA or approved equal.

420.4 MANHOLE STEP REMOVAL AND STEP INSTALLATION

- 420.4.1 Existing deteriorated steps shall be removed and surrounding loose or deteriorated structure removed to sound material. Care shall be taken to avoid damaging other parts of the manhole. Loose and broken brick and mortar shall be removed from the manhole to eliminate the possibility of pieces entering the sewer lines.
- 420.4.2 After removal of the existing deteriorated steps and surrounding areas, holes shall be patched in accordance with the Drawings and Part 418 – Patching, Repairs, and Plugging Lift Holes.
- 420.4.3 Contractor shall, at no additional cost to City, replace any portion of the existing manhole, which is damaged during step removal, patching, or step installation.
- 420.4.4 When specified in the Drawings and Contract Documents, install replacement steps in accordance with manufacturer's recommendations.

420.5 MEASUREMENT AND PAYMENT

- 420.5.1 Step removal and, when specified, replacement, shall be paid for at the Contract Unit prices bid for Step Removal and Replacement (Type I Repair) per each step removed, regardless of size of manhole.
- 420.5.2 The prices shall be payment in full for performing and completing the work and for furnishing all labor and materials necessary including equipment, flow diversion, excavation, backfilling, pipe restoration or utility restorations, manhole cleaning, debris removal, step removal, hole preparation, patching and hole plugging, step installation (when specified), manhole surface restoration, and all testing per manhole for all steps removed.
- 420.5.3 The replacement of Manhole Steps bid item is only for manholes being rehabilitated. In manholes being rehabilitated, step condition shall be reviewed by the Engineer and Contractor and steps replaced if deemed necessary. Payment will be by the number of steps installed.

PART 421 – INTERIOR MANHOLE REHABILITATION – CORBEL (CONE) AND WALL REHABILITATION, BENCH AND INVERT, AND PIPE SEAL REHABILITATION

421.1 SCOPE

421.1.1 Work covered in this section consists of rehabilitation of manhole corbel or cone and walls, bench and invert, and pressure grouting and coating pipe seals including the lower 18" of the manhole, and pressure grouting precast joints. This Bid Item includes all interior manhole repairs below the chimney. Testing, cleanup, and materials requirements are also included.

421.1.2 The Contractor shall be responsible for the furnishing of all labor, supervision, materials, and equipment, including manhole cleaning, patching, repairs required to stop active leaks, corbel, wall, bench and invert, and pipe seal coating and grouting, and surface restoration, required to complete all rehabilitation and replacement work, and testing in accordance with the Contract Documents. This includes any follow-up rehabilitation work required of the Contractor by the ENGINEER.

421.2 MATERIALS

421.2.1 The Contractor shall be thoroughly trained and familiar with handling, mixing, and placing all material. All materials shall be used in strict accordance with manufacturer's recommendations and with the provisions of all OSHA and other safety regulations. Field conditions must be appropriate for and compatible with component mixing for the linings and sealants. All materials shall conform to and be installed according to manufacturer's recommendations and specifications. Contractor shall supply all necessary materials, including storage and transportation to the satisfaction of Engineer. Materials damaged by Contractor shall be replaced at no additional cost to the City. Existing manhole frames and covers being replaced shall become the property of City. Contractor shall dispose of existing castings at a site indicated by the Sewer Operations and Maintenance.

A) INTERIOR COATING: This Specification will describe minimum requirements for a one-component, rheoplastic, fiber or polypropylene-reinforced, shrinkage compensated mortar lining system for manhole wall and corbel (cone) rehabilitation. Coating materials for use in manhole rehabilitation shall conform to Strong Systems, Inc. MS-2A; Master Builders, Inc. Emaco S88C; Standard Cement Materials, Reliner MSP; Permacast MS 10,000; or Quadex QM-1s Restore; wall coating material may also be used for the bench and invert rehabilitation repair.

B) Design Mix. Design mix shall be a preblended mixture of cements, chemically active aggregates, glass fibers and other additives specifically selected for special properties. No material (other than water) shall be used with or added to the approved design mix without prior approval or recommendation from the ENGINEER.

C) Water Supply. All water used in the mixture shall be clean and potable.

- D) Certification. The Contractor must furnish certification to the ENGINEER that the coating system materials proposed for the project meet or exceed all of the minimum requirements as specified herein.
- E) Density. Density of the material at placement of the coating system shall not be less than 95 lbs./cubic feet.
- F) Working Time. Approximate working time of the material after initial application shall be 30 minutes.
- G) Compressive Strength. Compressive strength shall conform to ASTM C495 and C109 and shall meet or exceed a minimum 28-day break of 4,000 psi.
- H) Flexural Strength. Flexural strength shall conform to ASTM C348 and shall meet or exceed a minimum 28-day break of 1,200 psi.
- I) Slant Shear Bond Strength. Slant shear bond strength shall conform to ASTM 882 modified and shall meet or exceed a minimum 28-day break of 2,400 psi.
- J) Freeze-Thaw. Freeze/thaw testing shall conform to ASTM C666 and shall show no visible damage after 100 cycles.
- K) Permeability. Permeability of the formulation shall conform to ASTM T277 and shall be less than or equal to 450 Coulombs.
- L) Manholes scheduled for Interior Manhole Coating shall have a minimum 1" coating thickness for depths up to 12' measured from the lowest flowline elevation to the rim. For depths greater than 12', an additional 1/2" thickness shall be added to the manhole below the 12' depth. For example, a 15' deep manhole scheduled for Interior Manhole Coating would have the bottom 3' coated with a minimum coating thickness of 1-1/2" and the top 12' would have a minimum coating thickness of 1". The additional material thickness shall be considered subsidiary to the bid item Interior Manhole Coating and will not be paid for directly.

421.3 CHEMICAL GROUTING SYSTEMS

421.3.1 Where the pressurized injection of chemical grout behind the manhole walls and joints is required, the material supplied shall be a urethane gel with properties as follows:

- A) While being injected, the chemical sealant must be able to react/perform in the presence of infiltrating water.
- B) The cured sealant must be capable of withstanding submergence in water without degradation.
- C) The cured sealant must prevent the passage of water through the manhole defect.
- D) The cured sealant must be flexible as opposed to brittle or rigid.

- E) In place, the cured sealant shall be able to withstand freeze/thaw and wet/dry cycles without adversely affecting the seal.
- F) The cured sealant must not be biodegradable. Additives may be used to meet this requirement, without affecting long-term strength.
- G) The cured sealant shall be chemically stable and resistant to concentrations of acids, alkalis, and organics found in normal sewage.
- H) Packaging of component materials must be compatible with field storage and handling requirements. Packaging must provide for worker safety and minimize spillage during handling.
- I) In the event that the chemical sealant may be harmful by passing through the unbroken skin, by inhalation of dust, vapor or mist, or by swallowing, the handling and mixing shall be performed with proper equipment and by personnel thoroughly familiar with the chemicals involved and shall be in strict accordance with the manufacturer's recommendations and with the provisions of all safety regulations.
- J) Mixing of component materials must be compatible with field conditions.
- K) Residual sealing materials must be easily removable from the bench of manhole to prevent reduction or blockage of the sewer flow.
- L) Urethane gel grout shall be utilized for the entire manhole.
- M) No grouting operations shall be performed at temperatures below 40° F or where the temperature of the groundwater is below 40° F.

421.4 URETHANE GEL: URETHANE GEL SHALL HAVE THE FOLLOWING PROPERTIES AND CHARACTERISTICS:

- 421.4.1 One-part urethane prepolymer thoroughly mixed with between five and ten parts water by weight. The recommended mix ratio is one-part urethane prepolymer to eight parts of water (11% prepolymer).
- 421.4.2 A liquid prepolymer having a solids content by weight of 77% to 83%, specific gravity of 1.04 (8.65 pounds per gallon), and flash point of 200° F.
- 421.4.3 A liquid prepolymer having a viscosity of 600 to 1,200 centipoise at 70° F, that can be pumped through 500' of 1/2" hose with a 1,000-psi head at a one-ounce per second flow rate.
- 421.4.4 The water used to react the prepolymer should be in the pH range of 6.5 to 8.0.

- 421.4.5 A cure time of 80 seconds at 40° F, 55 seconds at 60° F, and 30 seconds at 80° F, when one-part prepolymer is reacted with eight parts of water only. Higher water ratios give longer cure times.
- 421.4.6 A cure time that can be reduced to ten seconds for water temperatures of 40° F to 80° F when one-part prepolymer is reacted with eight parts water containing gel control agent.
- 421.4.7 A relative rapid viscosity increase of the prepolymer/water mix. Viscosity increases from about 10 to 60 centipoise in the first minute for 1:8 prepolymer/water ratio at 50° F.
- 421.4.8 A reaction (curing) which produces a chemically stable, non-biodegradable, tough, flexible gel.
- 421.4.9 The ability to increase mix viscosity, density, gel strength, and resistance to shrinkage by using additives in the water component of the grout.
- 421.4.10 The ability to accept suspended additives such as 2,6-dichlorobenzonitrile root control.
- 421.4.11 Contain a minimum of 15% shrink control agent supplied by the same manufacturer.

421.5 MATERIALS DELIVERY AND STORAGE

- 421.5.1 The Contractor shall provide adequate facilities for storage of raw materials and for preparation of the materials for installation. They shall conform to the manufacturer's recommendations and all applicable codes, regulations, and safety requirements. These facilities shall be approved by the ENGINEER prior to initiation of manhole rehabilitation or replacement and shall be provided by the Contractor at no additional cost. Materials stored will not be paid for.

421.6 MATERIALS TESTING

- 421.6.1 Testing shall be the responsibility of the Contractor. Tests for compliance with this Specification shall be made as specified herein and in accordance with the applicable Specification. A Certificate of Compliance with this Specification along with a report of each test, shall be furnished by the Contractor for all material furnished under this Specification. The Contractor shall inform the ENGINEER as to when, where and by whom, testing will be conducted, at least one week prior to testing. The ENGINEER may, at its own expense, witness testing of the materials.

421.7 WALL REHABILITATION (TYPE Gg)

- 421.7.1 General. Corbel and wall rehabilitation shall be performed by the installation of approved coatings. The type of rehabilitation system to be utilized for each manhole shall be identified in the Drawings.

421.7.2 Manholes that are scheduled to interior manhole coating, and that are above grade with manhole components exposed shall have the exposed exterior corbel and wall of the manhole coated using approved coating materials and in accordance with manufacturer's recommendations and specifications for exterior application.

Prior to performing the work, the Contractor and Engineer will jointly inspect the manhole exterior and agree upon the scope and extent of exterior coating required. Exterior coating shall be performed on:

- A) Manholes with exposed brick or block.
- B) Brick or block manholes with a cracked or otherwise damaged exterior mortar coating.
- C) Other manholes, as required by the Engineer. Exterior coating of precast or Cast-In-Place concrete manholes in good condition shall not normally be required. Based on the condition of the manhole exterior, the Engineer may require that only portions of the manhole exterior be coated.

Materials utilized for coating the exteriors of manholes shall conform to the requirements of Part 421.2.1.

421.7.3 Installation of a coating system shall entail the preparation of the manhole interior, application of the liner, and testing.

421.7.4 Interior Coatings. It is the intent of this section to govern all aspects of internal rehabilitation of manhole corbels, walls, bench and invert, and pipe seals using a high-strength, waterproofing, coating system. Manhole defects shall be repaired where shown or specified, or as directed by ENGINEER. Repair of manhole defects shall be accomplished by the methods specified herein. All manufacturer's recommendations shall be strictly followed for the entire rehabilitation procedure, including cleaning and possible surface preparation of the interior of the manhole, storing, and preparing the products and sealing the manholes. The work consists of spray and/or trowel applying an interior coating mix to the corbel, walls, benches and inverts, and pipe seals of manholes, resulting in a monolithic liner of a minimum 1" thickness for depths up 12'. For depths greater than 12', an additional 1/2" thickness shall be added to the manhole below the 12' depth. The applicator, approved and trained by the coating manufacturer, shall furnish all labor, equipment, and materials for applying the system over brick, tile, precast concrete, or concrete block manholes.

A) Preparation:

- 1) Place bench covers over invert before prepping manhole. Contractor shall prevent all construction materials from entering sewer pipelines.
- 2) All foreign materials shall be removed from the manhole walls and bench using high pressure water spray (minimum 3,500 psi). Loose and protruding brick, mortar and concrete shall be removed using a mason's hammer and chisel

and/or scrapers. Voids shall be filled with Octocrete as manufactured by IPA, Strong-Seal QSR as manufactured by Strong Systems, Inc., or approved equal, at least one hour prior to spray application of the coating system.

- 3) Active leaks shall be stopped using products specifically for that purpose. Ipanex-R as manufactured by IPA, or approved equal, mixed in accordance with manufacturers recommendations. If necessary, water shall be channeled to the bottom of the manhole structure through one or more weep holes and allowed to weep during the coating process. Once the walls of the manhole have been rehabilitated, weep holes shall be plugged with Ipanex-R or approved equal.
 - 4) After all preparation has been completed, Contractor shall remove all loose material.
- B) Mixing: Contractor shall follow published recommendations of the manufacturer for mixing of all products.
- C) Spraying:
- 1) Prior to spraying, the surface shall be damp without noticeable free water droplets or running water. If required by the manufacturer, bond-coat slurry will be applied to the surface prior to application of the formulation. Material shall be spray applied to a minimum 1" uniform thickness to ensure that all voids and crevices are filled, and a smooth surface remains after troweling. The troweling shall compact material into voids and crevices and "set" the bond on the manhole surface (brick, tile, block, or concrete). Wall/Corbel coating shall not go above top of corbel.
 - 2) After the coating application to all vertical surfaces has been completed, the temporary bench covers shall be removed and the bench reconstructed with the coating mix from walls to the invert in such a manner so as to produce a bench having a gradual slope from the walls to the invert with the wall/bench joint interface built up and rounded to a uniform radius the entire circumference of the manhole. The thickness of the bench shall be no less than 3/4" at the invert and shall increase in the direction of the wall so as to provide the required minimum slope as shown on the Drawings.
 - 3) No application shall be made when ambient temperatures are less than manufacturer's recommendations and when freezing is expected within 24 hours unless specific recommendations are made by the manufacturer. If ambient temperatures are in excess of 90° F, precautions shall be taken to keep mixing water below 85° F, using ice if necessary.
 - 4) The final application shall have a minimum of four hours cure time before being subjected to active flow.
- A) A minimum of two test cylinders shall be taken from each day's work with the date, location and job recorded on each. The cylinders shall be sent to a certified

concrete testing laboratory, where a 28-day compression test will be made and recorded. Cost of testing shall be the responsibility of the Contractor.

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

C) Residual filler and formulations must be easily removable from the sanitary sewer line and manhole trough to prevent blockage of flow and minimize the amount of solids that enter the waste stream.

421.8 MANHOLE GROUTING

421.8.1 PRESSURE GROUTING: All manholes listed for interior rehabilitation shall have pipe seals pressure grouted and coated. Pressure grouting shall be done in accordance with the Drawings. Any structurally unsound manholes observed by Contractor shall be replaced as directed by ENGINEER.

421.8.2 The existing manhole structure designated for pressure grouting for pipe seals or for precast joints shall be thoroughly cleaned prior to grouting. Contractor shall dispose of all debris and prevent any debris from entering the existing sewer lines.

421.8.3 Grade adjustments, frame and cover replacements, chimney repairs, frame seals and other repairs shall be performed prior to pressure grouting. Pressure grouting shall be done prior to interior coating. All roots exposed in the manhole shall be removed.

421.8.4 Grouting of the manhole may include precast wall joints, pipe seals, and/or bench and invert. Areas and specific manholes requiring grouting shall be specified in the Schedule in the Drawings.

421.9 PIPE SEAL COATING AND PRESSURE GROUTING (TYPE Gk)

421.9.1 Injection holes shall be drilled in accordance with the Drawings. After removal of the grouting probe, activated oakum rope shall be used to fill the injection hole. Pipe seal pressure grouting will include the entire lower 18" of the manhole. Injection hole shall be patched with waterproof, quick setting mortar and covered with a moisture resistant two-part epoxy adhesive coating. Any pipe damaged by Contractor while drilling the injection hole shall be replaced at no expense to City.

421.9.2 Contractor shall, at no additional cost to City, replace any portion of the existing manhole or pipe, which is damaged during pipe sealing.

421.9.3 The deteriorated area of the pipe seal shall be removed to sound material. Care shall be taken to avoid damaging other parts of the manhole structure. Loose and broken brick, mortar, concrete, and pipe shall be removed from the manhole.

- 421.9.4 Bonding agent, Weld-Crete as manufactured by Larsen Products Company or approved equal, shall be applied to existing surfaces in accordance with manufacturer's recommendation.
- 421.9.5 Contractor shall place Octocrete, as manufactured by IPA, or approved equal to the area. Octocrete shall be placed in such a manner that it is consolidated, fills existing voids, and creates a smooth, dense surface in accordance with the Drawings.
- 421.9.6 Wastewater flow shall be maintained by methods which prevent contact with new pipe seal for 6-8 hours after Octocrete placement.
- 421.9.7 The pipe seal shall form a water-tight seal with the manhole wall, bench, trough, and pipe. The manhole and pipes shall be cleaned of all debris and foreign matter.
- 421.9.8 All manholes scheduled for Corbel and Wall Rehabilitation, interior coating, shall have pipe seals and the lower 18" of the manhole drilled and grouted. The lower 18" is measured from the lowest flowline elevation up 18". Drilling and grouting the lower 18" shall include at least two rows of drill and grout holes. Grouting the pipe seals and the lower 18" is subsidiary to Interior Manhole Coating and will not be paid for directly.
- 421.9.9 Additional grouting above the bottom 18" is not expected to be needed. Contractor is responsible to stop all active inflow and infiltration leaks in the manhole prior to placing the interior coating. Work and materials required to stop leaks in the manhole are considered subsidiary to Interior Manhole Coating and will not be paid for directly.
- 421.9.10 Drop manholes scheduled for Interior Manhole Coating shall have the pipe seals of all grade lines and drop lines grouted in addition to the bottom 18" of the manhole. All incoming and outgoing pipe seals shall be grouted, regardless of the height above the flowline of the manhole.
- 421.10 SEAL PRECAST JOINTS – PRESSURE GROUTING (TYPE Gp)
- 421.10.1 General: Prior to pressure grouting of manholes specified in the Drawings, all unsealed step holes, missing pipe seals and unsealed lift holes shall be repaired. A quick-setting cement and bricks, when necessary, shall be used to fill these defects. After the setting of the hydraulic cement, the repair shall be covered with a moisture resistant two-part epoxy adhesive coating such as Aquatapoxy as manufactured by American Chemical Corp. or approved equal.
- 421.10.2 Grout Material Utilization
- A) Corbel and Frame, Wall, Pipe Seal, Bench and Invert: Urethane grout or other approved chemical pressure grout shall be utilized for the entire manhole.
- B) No grouting operations shall be performed at temperatures below manufacturer's recommendations or where the temperature of the groundwater is below manufacturer's recommendations.

421.10.3 Corbel and Wall Grouting

- A) Surface Preparation: Prior to pressure grouting of manhole corbel, entire surface area shall be coated with a layer of dry polymer mortar in accordance with the manufacturer's recommendations. Dry polymer mortar shall not be applied to the wall portion of the manhole unless grout migration back into the manhole is observed during the grouting operation. No drilling or pressure grouting shall be done until the dry polymer mortar has been allowed to dry for a period of 24 hours. The dry polymer mortar shall extend to a point 12" below the corbel to wall joint. The dry polymer mortar shall be Octocrete as manufactured by IPA Systems, Inc., or approved equal.
- B) Corbel Drilling: A minimum of four injection holes shall be drilled at 90° angles from each other at the same plane of elevation. Additional rows shall be separated by a distance of 18", and the holes shall be staggered with the holes in the rows above and below in accordance with the Drawings. After removal of the grouting probe, activated oakum rope shall be used to fill the injection holes. Injection holes shall be patched with a waterproof quick setting mortar.
- C) Wall Drilling: A minimum of four injection holes shall be drilled at 90° angles from each other at the same plane of elevation. Additional rows shall be separated by a distance of 24", and the holes shall be staggered with the holes in the rows above and below in accordance with the Drawings. After removal of the grouting probe, activated oakum rope shall be used to fill the injection holes. Injection holes shall be patched with a waterproof quick-setting mortar.

421.11 PRECAST JOINT SEALING

- 421.11.1 Pressure Grout: A minimum of four injection holes shall be drilled at 90° angles from each other at the same plane of elevation approximately 6" above the precast section joint. An additional row of holes shall be drilled 6" below the joint staggered by 45° as shown in the plans. After removal of the grouting probe, activated oakum rope shall be used to fill the injection holes. Injection holes shall be patched with a waterproof, quick-setting hydraulic cement.

421.12 MEASUREMENT AND PAYMENT

421.12.1 Wall Rehabilitation (Type Gg):

- A) Wall Rehabilitation shall be paid for at the unit price bid per square foot of manhole corbel or wall area rehabilitated. Corbel or wall area rehabilitated shall be measured as the interior and/or exterior surface area actually coated, measured to the nearest 0.1 square foot.
- B) In manholes where Wall Rehabilitation is performed, Bench and Invert Rehabilitation, Pipe Seal Coating and Pressure Grouting, Lift Hole Plugging, Precast Joint Sealing, and Hole Patching shall be paid for separately at the unit price bid for each individual item.

- 421.12.2 Bench and Invert Rehabilitation (Type Gh): Bench and Invert Rehabilitation shall be paid for at the unit price bid per manhole, regardless of the size of the manhole or the number, diameter, or material, of the line segments connecting the manholes.
- 421.12.3 Pipe Seal Coating and Pressure Grouting (Type Gk): Pipe Seal Coating and Pressure Grouting shall be paid for at the unit price bid per manhole, regardless of the size of the manhole or the number, diameter, or material of the line segments entering the manholes.
- 421.12.4 Lift Hole Plugging (Type Go): Lift Hole Plugging shall be paid for at the unit price bid per manhole, regardless of the size of the manhole or the number of lift holes to be plugged.
- 421.12.5 Pre-cast Joint Sealing (Type Gp): Pre-cast Joint Sealing shall be paid for at the unit price bid per manhole, regardless of the size of the manhole of the number of joints sealed.
- 421.12.6 Hole Patching (Type Gr): Hole Patching shall be paid for at the unit price bid per manhole, regardless of the size or number of the holes to be patched.
- 421.12.7 Epoxy Coating (Type Gs):
- A) Epoxy coating shall be paid for at a unit price bid per square foot of manhole corbel or wall area rehabilitated. Wall area rehabilitated shall be measured as the interior surface area actually coated, measured to the nearest 0.1 square foot.
 - B) In manholes where Epoxy coating is performed, Bench and Invert Rehabilitation, Pipe Seal Coating and Pressure Grouting, Lift Hole Plugging, Pre-cast Joint Sealing, and Hole Patching shall be paid for separately at the unit price bid for each individual item.

PART 422 – MANHOLE TESTING OF NEW AND REHABILITATED MANHOLES

422.1 GENERAL

422.1.1 Scope

- A) This section describes manhole testing to effectively confirm the water-tight integrity of new manholes and existing manholes following infiltration related repairs and inflow related repairs.

422.1.2 Description

- A) Infiltration may be observed in manhole defects at manhole walls, pipe seals or bench/trough areas. Infiltration related repairs are intended to eliminate leakage of groundwater into manholes.
- B) Inflow may be observed in manhole defects at manhole frames, covers, frame seals, grade adjustments, grade adjustment seals, corbels, or walls. Inflow related repairs are intended to eliminate sources of surface water entry that become active during rainfall events.

422.1.3 Testing, Observations, and Guarantee Periods

- A) The testing required shall be performed by the Contractor at locations designated by the Engineer and documented to the satisfaction of the Engineer.
- B) Any new or rehabilitated manholes that are observed to be leaking by the Engineer during periods of high groundwater or during inflow conditions shall be subject to additional repairs. The Contractor shall be responsible for all additional repairs required on unsatisfactory manholes during the guarantee period.

422.2 MATERIALS

422.2.1 Not specified.

422.3 EXECUTION

422.3.1 Infiltration Testing

- A) All of rehabilitated manholes and all of new manholes shall be observed (tested) by the Contractor in the presence of the Engineer for sources of infiltration. Observations will be made during high groundwater conditions, wherever possible.
- B) Manholes shall be tested after installation with all connections (existing and/or proposed) in place. Drop-connections and gas sealing connections shall be installed prior to testing. The lines entering the manhole shall be temporarily plugged with the plugs braced to prevent them from being drawn into the manhole. The plugs shall be installed in the lines beyond drop-connections, gas sealing

connections, etc. The test head shall be placed inside the frame at the top of the manhole (so that the manhole frame seal is tested) and inflated in accordance with the manufacturer's recommendations. A vacuum of 10" of mercury shall be drawn, and the vacuum pump will be turned off. With the valve closed, the level of vacuum shall be read after the required test time. If the drop in the level is less than 1" of mercury (final vacuum greater than 9" of mercury), the manhole will have passed the vacuum test. After a successful test, the temporary plugs will be removed. The required test time is determined from Table I.

Table I
MINIMUM TIME REQUIRED FOR A VACUUM DROP
OF 1" Hg (10" Hg – 9" Hg) (MIN:SEC)

HEIGHT OF M.H. (DEPTH IN FT.)	48" M.H.	60" M.H.	72" M.H.
4	10.0 sec.	13.0 sec.	16.0 sec.
8	20.0 sec.	26.0 sec.	32.0 sec.
12	30.0 sec.	39.0 sec.	48.0 sec.
16	40.0 sec.	52.0 sec.	64.0 sec.
20	50.0 sec.	65.0 sec.	80.0 sec.
24	60.0 sec.	78.0 sec.	96.0 sec.
**	T = 5.0 sec.	T = 6.5 sec.	T = 8.0 sec.

**For all Manholes over 24' in depth, add the "T" seconds as shown for each respective diameter for each 2' of additional depth of manhole to the time shown for that 24' depth. [Example: A 30' deep, 48" Manhole Total Test Time would be 75.0 seconds. $60.0 + 3(5.0) = 75.0$ seconds] (Values listed above are extrapolated from ASTM C924-85).

- C) Manhole vacuum levels observed to drop greater than 1" of mercury (Final vacuum less than 9" of mercury) will have failed the test and will require additional rehabilitation. The Contractor shall make the necessary repairs to the already completed rehabilitation work at no additional compensation. If the failure of the vacuum test is determined to be due to preexisting conditions not on the manhole rehabilitation schedule for that manhole, this additional work may be authorized by the Engineer. After completion of the additional rehabilitation the manhole shall then be retested as described above until a successful test is made.
- D) If it is determined by the Engineer that additional rehabilitation work items need to be completed on a manhole that has failed the vacuum test, these may be authorized. After the additional work is completed, the manhole will be retested.

422.3.2 Inflow Testing

- A) All of rehabilitated manholes and all of new manholes shall be dyed water tested unless the manhole has successfully passed the vacuum test. Manholes shall be dyed water tested in the presence of the Engineer. The dye test shall consist of applying a concentrated dye solution around the manhole frame. Dyed water shall be applied for at least ten minutes.

B) Manholes observed to be actively leaking greater than one drip per five seconds will have failed the test and will not be acceptable. Manholes failing the test will require additional rehabilitation by the Contractor at no additional compensation.

422.4 MEASUREMENT AND PAYMENT

422.4.1 The cost of manhole testing will not be paid for separately but shall be included in the Contract Unit Price of the rehabilitation or replacement being performed.

PART 423 – OBSTRUCTION REMOVAL

423.1 GENERAL

- 423.1.1 **INTENT:** Obstruction removals are excavations to clear obstructions such as solids, dropped joints, crushed or collapsed pipe, and reductions in the cross-sectional area of more than 20% that will prevent pre-construction television inspection and associated pipeline rehabilitation.
- 423.1.2 **TELEVISION INSPECTION:** Obstructions indicated on the Drawings are based on previously performed television inspections. The exact location of the obstruction removal will be determined by internal television inspection prior to excavation. The television video will have a digital footage display on the screen and shall be reviewed by ENGINEER prior to excavation to determine the extent of the repair as indicated on the Drawings.
- 423.1.3 **NOTIFICATION:** CONTRACTOR shall notify ENGINEER not less than 48 hours in advance of the time he plans to begin work at a particular location with the Project.

423.2 MATERIALS

- 423.2.1 **BACKFILL:** Backfill, including pipe bedding, shall be placed and compacted as specified in Part 403.

423.3 PROCEDURE

- 423.3.1 The Contractor shall identify all obstructions for the sewer section scheduled for rehabilitation.
- 423.3.2 If the Contractor identifies obstructions that cannot be removed by conventional sewer cleaning equipment, then, with the Engineer's approval, an excavation shall be made to remove the obstruction. The repair shall be an adequate repair for insertion of required equipment or material. This shall be paid at the bid price for obstruction removal.
- 423.3.3 **Surface Restoration:** Service and lateral pits, and other work areas shall be restored to condition as good as that before construction occurred. Disturbed grasses shall be sodded in accordance with Part 402 – Restoration. Pavements removed or damaged shall be replaced. Concrete embankment shall be replaced or installed at locations indicated in the Drawings and in accordance with these specifications.

423.4 MEASUREMENT AND PAYMENT

- 423.4.1 Obstruction Removal shall be paid for at the Contract Unit Price for each obstruction removal actually performed.
- 423.4.2 Protruding Service connection removal and replacement shall be paid for at the Contract Unit Price for Service Connection.

423.4.3 The prices shall be payment in full for performing and completing the work and for furnishing all labor and materials necessary including excavation and removal of existing structure, trench safety system, pipe repair materials, connectors, pipe sealing materials, labor, backfilling, surface restoration, testing, and all incidental costs.

PART 424 – CURED-IN-PLACE SECTIONAL AND SPOT REPAIR

424.1 GENERAL

424.1.1 It is the intent of this specification to provide for the reconstruction of a particular section of sewer pipe without excavation. The reconstruction will be accomplished using a non-woven fabric tube of particular length and a thermoset resin with physical and chemical properties appropriate for the application. The tube is impregnated with the resin and then placed inside or over a protective launching device with a translucent bladder and then winched into the existing sewer. The inflation bladder, when expanded, will conform to the host conduit. When the launching device is properly positioned, the end is opened, and the resin-saturated tube is moved into place. Once the tube/resin composite is cured, the inflation bladder and the launching device are removed.

424.1.2 Reference Standards

A) Installation and material tests of Cured-In-Place sectional and spot repair must meet the minimum requirements demonstrated in the following standards:

ASTM F1216	Standard Practice for the Installation of Cured-In-Place Pipe by Inversion Lining
ASTM F1743	Standard Practice for Rehabilitation of Existing Pipelines and Conduits by Pull-In-Place Installation of Cured-In-Place Thermosetting Resin Pipe (CIPP)
ASTM D790	Test Method of Flexural Properties of Plastics: Flexural Strength 4,500 psi (minimum) and Flexural Modulus 250,000 psi (minimum)
NASSCO	Specifications for Sewer Collection System Rehabilitation

424.2 MATERIALS

424.2.1 Tube

A) The tube shall consist of one or more layers of flexible needled felt or an equivalent nonwoven material capable of carrying resin, withstanding installation pressures and curing temperatures. The tube shall be compatible with the resin system used. The tube shall be capable of conforming to offset joints, bells, and disfigured pipe sections. The tube shall be fabricated to a size that, when installed, will tightly fit the internal circumference of the original conduit. Allowance shall be made for circumferential stretching during inversion.

424.2.2 Resin

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

- B) Resin – The resin used shall be high-grade corrosion resistant isophthalic polyester, vinyl ester, or epoxy, specifically designed for the Cured-In-Place sectional and pipe repair being installed.
- C) The minimum length shall be that deemed necessary by the ENGINEER to effectively span the entire pipeline defect being corrected to sound pipe beyond either end of the defect, unless otherwise specified. The required minimum lengths shall be verified in the field before impregnation of the tube with resin.

424.3 EXECUTION

424.3.1 Pre-Installation Procedures

A) Safety

- 1) CONTRACTOR shall carry out his operations in strict accordance with all OSHA and manufacturer's safety requirements. Particular attention is drawn to those safety requirements involving working with scaffolding and engineering confined spaces.

B) Cleaning and Inspection

- 1) CONTRACTOR shall clean and inspect each line immediately prior to reconstruction utilizing a pan and tilt camera capable of verifying active or inactive service connections and the overall structural condition of the pipeline. All roots, debris, and protruding service connections shall be removed prior to reconstruction. Inspection shall include the complete length of the line from manhole to manhole.
- 2) Prior to installing Cured-In-Place sectional and point repairs, the CONTRACTOR shall verify that service connections are active by introducing dye into the lines at cleanouts, vent stacks or other access points as approved by the Engineer. Dye testing shall be recorded by CCTV inspection at the location in the main line where the dye appears. All addresses will be noted on log sheets for future reference. The CCTV camera shall be equipped with a rotating head and shall be pivoted to provide a view into each service line.

C) Line Obstructions and Point Repairs

- 1) The original pipeline shall be clear of obstructions such as solids, dropped joints, protruding service connections, crushed or collapsed pipe, and reductions in the cross-sectional area of more than 20%. Protruding service connections shall be removed to prevent dimpling of the finished liner. Maximum allowable protrusion shall be 1/2". If inspection reveals an obstruction that cannot be removed by conventional sewer cleaning equipment, then a point repair excavation shall be made per Part 411.

- 2) If, during pre-television inspection, the CONTRACTOR identifies dropped joints, line sags, or sections requiring repairs not scheduled, he shall notify the ENGINEER. The ENGINEER will determine whether such defects require correction by Cured-In-Place sectional and spot repair and/or by point repair excavation. The CONTRACTOR shall not perform such additional repairs without prior approval from the ENGINEER.

D) By-Pass of Flow and Interruption of Service

- 1) The lines scheduled for Cured-In-Place sectional and spot repair shall have all flows bypassed around them when determined necessary by the Engineer to ensure adequate conveyance of flow during repair. The pumping system shall be sized for normal to peak flow conditions. The upstream manhole shall be monitored at all times and an emergency deflate system shall be incorporated so that plugs may be removed at any time without requiring confined space entry.
- 2) When preparing for making connection to the existing system or other work, which will interrupt service to the utility users, CONTRACTOR shall notify the affected user at least 48 hours in advance of service interruption, stating the approximate time and duration of interruption of service. Advance notification shall not extend beyond 72 hours.
- 3) Public advisory services will be required to notify all parties whose service laterals will be out of commission and to advise against water usage until the mainline is back in service.

424.3.2 Installation of Lines

- A) The tube shall be inspected for tears or frayed sections. Tubes failing the inspection shall be immediately removed from the job site and replaced with suitable sections at no additional cost to City. Tubes passing the inspection shall be impregnated with the thermoset resin.
- B) No uncontrolled pouring of resin will be allowed during tube saturation. All resin shall be contained. CONTRACTOR shall ensure that no public or private property is exposed to contamination by liquid resin components or compounds.
- C) The saturated tube, with inflation bladder where required by the installation process, shall be pulled into the host pipe in accordance with the manufacturer's standard specifications. The pull shall be complete when the tube is properly aligned with the section of the host pipe being reconstructed. Any loss of resin required for development of proper wall thickness and curing of the repair or any loss of resin into the collection system creating an obstruction will not be permitted. Any resin lost during the insertion process shall be caught and removed from the system at the next downstream manhole. No contamination or dilution of the resin by exposure to dirt, debris, or water during the pull will be permitted.

- D) When required, the tube shall be inverted out of the launching device by controlled air or water pressure. The tube shall be held tightly in place against the wall of the host pipe by the applied pressure until the cure is complete. The resin and tube shall be completely protected during the curing. No contamination or dilution of the tube/resin composite by exposure to dirt, debris, or water during curing will be permitted.
- E) When the curing process is completed, the pressure shall be released and the inflation bladder and launching device shall be removed from the host pipe with the winch. No barriers, coatings, or any material other than the cured tube/resin composite shall be left in the host pipe. Any materials other than the cured tube/resin composite used in the installation shall be removed from the pipe by the CONTRACTOR.

424.3.3 Service Connections

- A) After the tube/resin composite has been cured, CONTRACTOR shall reconnect the existing active service connections. Service connections shall be reinstated by one of two methods. In general, service connections shall be reinstated internally in accordance with Part 423.3.b. Where service connections are found to be protruding or otherwise defective (i.e., end of service connection is broken away or irregular such that the full circumference of the service line would not contact with the Cured-In-Place Pipe) reinstatement shall be an external service reconnection in accordance with Part 423.3.c.
- B) Internal Reconnection: Without excavation, the service connection shall be reinstated by means of a television camera and a cutting device that re-establishes the connection to not less than 90% capacity. Service connections shall be cut in with neat and smooth circumferential lines to prevent snagging of debris and/or solids. CONTRACTOR shall provide a physical demonstration, in the presence of the Engineer, to show the assurance of a watertight seal of all service connections.
- C) External Reconnection: Service connections shall be reinstated by excavation and reconnecting the service with an approved saddle. The CONTRACTOR shall remove the appropriate amount of carrier pipe to allow the saddle to be directly connected to the outside wall of the CIPP. An epoxy, meeting the manufacturer's recommendations, shall be applied to the saddle to assure a water-tight seal between the saddle and CIPP. The saddle shall be secured with stainless steel bands. After the epoxy has set and prior to backfilling, the CONTRACTOR shall seal any open annular space between the existing sewer and new liner pipe with a non-shrink grout. The service connection riser shall be carried from the main to the existing elevation of the connection, utilizing bell and spigot cast iron soil pipe. At a location approved by the ENGINEER, a connection between the existing lateral service and the new service shall be made, utilizing a solid sleeve coupling, Rockwell Omni, OCUT sewer connector, or approved equal. The CONTRACTOR shall then completely encase the saddle and exposed pipe in concrete. Care shall be used not to damage the CIPP. If damage occurs as a result of the

CONTRACTOR'S operations, the CONTRACTOR shall assume all cost associated with the repair of the CIPP.

- D) It is the intent for service connections to be re-opened by internal reconnection where a watertight seal can be made. Where service connections are identified by TV inspection as defective, they shall be re-opened by external reconnection.
- E) Service interruptions to any home tributary to the sewer line being rehabilitated shall not exceed 24 hours.
- F) If external service connections are identified, the Engineer shall determine if a point repair should be made by the remove and replace method.

424.3.4 Final Inspection

- A) Upon completion of the installation, the rehabilitated sewer shall be CCTV inspected providing both a video recording and log identifying all service connections and openings, in accordance with Part 415 – Construction of Television Inspection of Sanitary Sewers.
- B) Visual inspection of the sectional and spot repair shall be in accordance with ASTM F1216, Section 8.6.
- C) Upon acceptance of the installation work and testing, the CONTRACTOR shall restore the project area affected by the operations to a condition at least equal to that existing prior to the work.

424.4 MEASUREMENT AND PAYMENT

- 424.4.1 Cured-In-Place Sectional and Spot Repair shall be paid for at the applicable Contract Unit Price as follows: The unit price shall cover the entire cost of Cured-In-Place sectional and spot repair for a 6' length.
- 424.4.2 Additional length of Cured-In-Place sectional and spot repair in excess of 6' shall be paid for at the applicable Contract Unit Price measured to the nearest 1'.
- 424.4.3 The prices shall be payment in full for performing and completing the work and for furnishing all labor and materials necessary including excavation and removal of existing structure, trench safety system, pipe repair materials, connectors, pipe sealing materials, labor, backfilling, surface restoration, testing and all incidental costs.
- 424.4.4 Service reconnections within the point repair area shall be included with the unit price bid for the point repair.
- 424.4.5 Pre-installation television inspection and cleaning shall be paid for by bid unit price per foot of sewer line inspected. All post-television inspection shall be included in price of repair in accordance with Part 415.

PART 425 – SEALED MANHOLE FRAME AND COVER

425.1 GENERAL

- 425.1.1 The Contractor shall install a sealed frame and cover when performing manhole repair Types A (manhole frame, cover and frame seal) and C (manhole frame, cover, frame seal, and chimney) within the City of Tulsa regulatory flood plain boundary, as shown on the plans, or when directed by the Engineer.
- 425.1.2 Manhole frame and cover repairs shall adhere to City of Tulsa Construction Specifications Part 418 – Replacement of Manhole Frame and Cover, Frame Seal, Chimney Seal, and Grade Adjustment; except where specified otherwise by this Part.

425.2 DEFINITIONS

- 425.2.1 Sealed frame and cover shall be defined as a frame and cover as described in City of Tulsa Standard Detail Nos. 352,353, or 354, as applicable, with the incorporation of a sealing gasket, bolts, and bolting pads.
- 425.2.2 Sealed Lamphole Frame and Cover shall be defined as a lamphole frame that among its attributes includes a minimum circular opening of 8.5” in diameter to conform to the City of Tulsa Standard Detail No. 360 (Standard Detail for Lampholes). In addition to the requirements of the referenced detail, the frame and cover shall incorporate a sealing gasket, bolts, and bolting pads.

425.3 MATERIALS

- 425.3.1 Sealed Frame and Cover shall be “Deeter 1265 – Bolted and Sealed” or “Deeter 1296 – Bolted and Sealed”, as applicable, with Tulsa emblem or equal.
- 425.3.2 Sealed Lamphole Frame and Cover shall be “Deeter 1828-B – Bolted and Sealed.”
- 425.3.3 Bolt threading for sealed manhole frame and cover shall be 5/8” at 11 threads per inch, unless specified otherwise by the Engineer. Bolts shall utilize the McGard locking system keyed to the City of Tulsa standard lock.
- 425.3.4 All other materials shall be in accordance with City of Tulsa Construction Specification Part 418 – Replacement of Manhole Frame and Cover, Frame Seal, Chimney Seal, and Grade Adjustment.

425.4 EXECUTION

425.4.1 Sealed Lamphole Frame and Cover

- A) Installation of a Sealed Frame and Cover shall result in a watertight installation conforming to the requirements of Special Detail No. 2.

- B) Contractor shall apply hydrophilic paste to ensure filling of any voids or pits on the pipe surface and to ensure adhesion of the hydrophilic waterstop to the pipe prior to placement of the concrete collar. Paste and waterstop shall be placed immediately prior to pouring of the concrete collar and kept from contact with water. Avoid premature wetting of the paste or waterstop in order to avoid premature swelling of the paste or waterstop. Paste or waterstop which begin to swell prior to placement of the concrete shall be removed and replaced prior to placement of the concrete collar. Follow all manufacturer's requirements for hydrophilic paste and hydrophilic waterstop.
- C) Concrete collar shall be placed and finished to a smooth, level surface. Troweleable bitumastic shall be placed in a layer 3/16" over the collar prior to placement of the frame and cover.

425.5 MEASUREMENT AND PAYMENT

- 425.5.1 Payment for the installation of a Sealed Frame and Cover, and payment for a Sealed Lamphole Frame and Cover shall be in addition to the prices bid for Type A, Type C repair, Type F repair, Manhole Replacement, Lamphole Replacement, or Lamphole Frame and Cover, for each Sealed Frame and Cover, and for each Sealed Lamphole Frame and Cover installed.
- 425.5.2 The price bid for a sealed Frame and Cover shall be payment in full for performing and completing all additional work and for furnishing all additional labor and materials necessary above and beyond the cost of a Type A or Type C repair.
- 425.5.3 The price bid for a Sealed Lamphole Frame and Cover shall be payment in full for performing and completing all additional work and for furnishing all additional labor and materials necessary above and beyond the cost of a Lamphole Frame and Cover, or a Lamphole Replacement.
- 425.5.4 No payment shall be made until the manhole and its adjacent area have been restored and the manhole and its appurtenances have satisfactorily passed testing.

SECTION END