

**SECTION 02565****SANITARY SEWER REHABILITATION****02565.01 GENERAL****A. Description**

Sanitary sewer rehabilitation shall include, but not necessarily be limited to, access for workers, material and equipment, sewer pipe cleaning, sewer flow control, television inspection, sewer pipe joint testing, sewer pipe joint sealing, sewer manhole sealing, sewer manhole rehabilitation, sewer manhole lining, slip lining, cured-in-place pipe lining, pipe and fitting replacement, and sewer manhole replacement in accordance with the Contract Documents. Sewer manhole replacement includes restoration of access ways preliminary to and during rehabilitation construction.

**B. Related Work Included Elsewhere**

1. Protection of environment; Section 01500.
2. Structure excavation; Section 02220.
3. Trench excavation, backfill, and compaction; Section 02250.
4. Sanitary sewer and sanitary sewer house connection installation; Section 02561.
5. Sanitary sewer manhole installation; Section 02562.
6. Sanitary sewer force main; Section 02563.
7. Connections to existing sanitary sewer facilities; Section 02564.

**C. Quality Assurance**

1. Materials
  - a. The Engineer will inspect all materials before and after installation to ensure compliance with the Contract Documents.
  - b. Special grouts, sealers, and coating systems shall be delivered to the site in the manufacturer's sealed, labeled, and dated containers. Storing and handling materials shall be in strict accordance with the manufacturer's instructions. Failure to properly store and handle material will result in rejection of material for use. Materials beyond the expiration date indicating the manufacturer's recommended shelf life will not be permitted to be used. A freezing weather limitation of 32 degrees will be enforced.

- c. Cured-in-place lining materials shall be chemically stable and resistant to concentrations of acids, alkalis, and organics found in sewage. The materials may be delivered to the site in either separate or pre-wetted fabrications in transportation containers designed to protect the integrity of the resin, catalyst, and liner. The time of resin and catalyst mixing will be recorded at the location of liner "wetting". Special handling instructions such as minimum or maximum temperature to be maintained during transportation and installation will also be recorded. Liners "wetted" for a time interval which exceeds the resin manufacturer's specified "pot life" at the recommended temperature will not be permitted to be used. Any evidence of setting before installation will result in rejection of material.
2. Field Testing
    - a. General
      - 1) After the item in question has been rehabilitated or replaced, it will be inspected by the Engineer and, if required herein, shall be Contractor tested for compliance with these Specifications. The Contractor shall furnish all labor, tools, materials, and equipment (except water as provided for in Section 02563.02, and timers which will be furnished by the County) necessary to perform the specified tests. All testing will be conducted under weather conditions typical of contract period to check performance under adverse conditions.
      - 2) The Contractor shall schedule all tests with the Engineer at least 48 hours in advance, and shall conduct all testing in the presence of the Engineer. The County will witness one test at no cost to the Contractor. If a portion of the Project is released for service following conditional acceptance tests, the County will perform a final inspection, if required, at no cost to the Contractor. Should the pipeline fail the first County witnessed test, the Contractor shall reimburse the County for all cost resulting from such additional tests so required until the pipeline passes the test(s). The Contractor shall also reimburse the County for the cost of inspection if the Contractor is not prepared for any test, or for additional test(s) required following the final inspection of released portions of the Project.
      - 3) If the item in question fails the test specified and/or inspection, the Contractor shall, at his own expense repair or replace any defective component in accordance with the manufacturer's recommendations and retest or have the Engineer reinspect the item until all requirements are met. Should any work be done by the County in the case of an emergency, the Contractor shall reimburse the County for

the actual cost of replacing such materials and making such installations.

b. Sewer Cleaning

- 1) After completion of sewer pipeline cleaning, the Engineer will visually, or by closed circuit television camera, inspect in whole or part the pipe system for which the cleaning task has been completed. Evidence of significant remaining sediment, debris accumulation, or root intrusion will result in rejection of the pipe system. The Contractor shall repeat his cleaning operation and retest the line until the sewer is satisfactorily cleared of sediment, debris, grease, and roots.
- 2) In areas where television inspection is not performed, the Engineer may require the Contractor to pull a double squeegee (with each squeegee the same diameter as the sewer), or propel a "GO/NO GO" ball through each section of pipeline cleaned as evidence of adequate cleaning.
- 3) Force mains will be accepted when they can pass a sewer ball which has a diameter of at least 95% of the line being cleaned.

c. Manhole Sealing and Rehabilitation

After manhole rehabilitation procedures have been performed, the manholes will be visually inspected by the Engineer for leakage. Any leak or seepage which produces a visible trickle or stream will be cause for rejection of the work.

d. Gravity Sewer Pipe

- 1) Sliplined Pipe: After installation, but before any house connections are reinstated, the liner pipe shall be low-pressure air tested by the Contractor in accordance with the procedures specified in Section 02561.01.
- 2) Cured-in-Place Pipe Lining: After installation procedures have been performed and curing complete, but before any house connections are reinstated, the pipeline shall be hydrostatically tested by the Contractor.
  - a) The test shall be conducted by using the existing hydrostatic head provided by the inversion standpipe providing this head is at least 7 feet above the prevailing groundwater elevation. The test time shall be 1 hour during which time no makeup

water shall be added to the standpipe. If, at the end of the test period, no water loss is observed in the standpipe, the cured-in-place pipe will be accepted.

- b) If water loss is observed in the standpipe, the lining will fail the test.
- e. Force Mains
  - 1) After installation procedures have been performed for either sliplined or cured-in-place pipe lining, the lined force main shall be hydrostatically tested by the Contractor.
  - 2) The completed liner shall be filled with water to eliminate all air and brought to the test gradient or pressure as indicated in the Contract Documents.
  - 3) After the system has been pressurized to the test pressure and the pumps disconnected, the liner shall hold the test pressure with no visible drop in pressure for 1 hour.

#### **D. Submittals**

- 1. Shop Drawings
  - a. Shop drawings shall be submitted as specified in the "General Provisions" for all materials other than those furnished by the County. The Contractor shall submit product information and detailed manufacturer's recommendations and instruction on the storage, handling, mixing (where appropriate), and installation of all materials intended to be used for rehabilitation.
  - b. For those materials which rely on chemical reactions and/or heat (energy) sources to obtain a "cure" of the materials, details shall be submitted indicating "pot life" after mixing; curing time; temperature limitations during transportation, application, and installation; and special handling requirements.
- 2. Certificates of Compliance
  - a. Certificates of compliance shall be submitted as specified in the "General Provisions" for materials listed in Section 02565.02 when indicated in the paragraph where the materials are specified.
  - b. Certificates of compliance shall be submitted for glass fiber-reinforced polyester manholes, polyethylene pipe, and reinforced plastic mortar pipe indicating the item supplied is in accordance with the referenced standard.

**02565.02 MATERIALS****A. Materials Furnished by the County**

Unless otherwise noted in the "Special Provisions" for the Bureau of Utilities Projects, the County will make available for one test only water from its potable water system to the Contractor at no charge.

**B. Contractor's Options**

1. The Contractor may furnish and install, unless otherwise noted, Polyethylene (PE), Reinforced Plastic Mortar (RPM), or cured-in-place liners, for lining existing gravity pipelines.
2. The Contractor may furnish and install Polyethylene (PE) or cured-in-place liners for lining existing force mains.

**C. Detailed Material Requirements**

1. Portland cement concrete for pipe encasement shall be Mix No. 1 as specified in Section 03310.
2. Quick-setting, non-shrink grout shall be as specified in Section 03600.
3. Chemical Sealing Materials
  - a. General
    - 1) The intent of this Item is to define the properties a sealing material shall have to perform effectively in the intended application and under expected field conditions.
    - 2) Generic chemical sealing materials currently used are listed with the basic properties, performance standards, and mix ratios which have previously given acceptable performance.
    - 3) It is recognized that new and improved chemical sealing materials may become available. Sources, manufacturers, and product names of chemical sealing materials will change and therefore specific sources, manufacturers, and product names are not referred to in this Specification.
    - 4) Sealing materials shall contain a root inhibitor.
  - b. All chemical sealing materials used in performance of the work specified shall have the following properties and characteristics:

- 1) While being injected, the chemical sealant shall be able to react/perform in the presence of water.
  - 2) The cured material shall be capable of withstanding submergence in water without degradation.
  - 3) The resultant sealant formation shall prevent passage of water.
  - 4) The sealant, after curing, shall be flexible as opposed to brittle or rigid.
  - 5) In place, the resultant sealant formation shall be able to withstand freeze/thaw and wet/dry cycles without adversely affecting the seal.
  - 6) The sealant formation shall not be biodegradable. Additives may be used to meet this requirement.
  - 7) The cured sealant shall be chemically stable and resistant to concentrations of acids, alkalis, and organics found in sewage.
  - 8) Packaging of component materials shall be compatible with field storage and handling requirements. Packaging shall provide for worker safety and minimize spillage during handling.
  - 9) Mixing of component materials shall be compatible with field operations and not require precise measurements.
  - 10) Cleanup shall be done without excessive use of flammable or hazardous chemicals.
  - 11) Residual sealing materials shall be removable from the sewer after injection to insure no flow reduction, restriction, or blockage of sewage flows.
- c. Acrylamide base gel chemical sealing material requirements, properties, and characteristics:
- 1) A minimum of 10% acrylamide base material by weight in the total sealant mix. A higher concentration (%) of acrylamide base material may be used, when desirable, to increase strength or offset dilution during the induction period.
  - 2) The ability to tolerate some dilution and react in moving water during the induction period.

- 3) A viscosity of approximately 2 centipoise which can be increased with additives.
  - 4) A constant viscosity during the induction period.
  - 5) A controllable reaction time (induction period) from 10 seconds to 1 hour.
  - 6) A reaction (curing) which produces homogeneous, chemically stable, nonbiodegradable, firm, flexible gel.
  - 7) The ability to increase mix viscosity, density, and gel strength by use of additives, e.g.: diatomaceous earth.
- d. Acrylate base gel chemical sealing material requirements, properties, and characteristics:
- 1) A minimum of 10%\* acrylate base material by weight in the total sealant mix. A higher concentration (%) of acrylate base material may be used, when desirable, to increase strength or offset dilution during the induction period.  
  
\*Note: If the acrylate base material is in a 40% solution, it shall comprise 25% by weight of the total sealant mix to have 10% base material.
  - 2) A low toxicity of the acrylate base material, i.e.: acute oral toxicity in rats (LD<sub>50</sub>) of 5000 mg/kg body weight of rats.
  - 3) The ability to tolerate some dilution and react in moving water during the induction period.
  - 4) A viscosity of approximately 2 centipoise which can be increased with additives.
  - 5) An essentially constant viscosity during the induction period.
  - 6) A controllable reaction time (induction period) from 10 seconds to 1 hour.
  - 7) A reaction (curing) which produces homogeneous, chemically stable, nonbiodegradable, firm, flexible gel.
  - 8) The ability to increase mix viscosity, density, and gel strength by the use of additives, e.g.: diatomaceous earth.

- e. Urethane base foam chemical sealing material requirements, properties, and characteristics:
- 1) Approximately 1 part of urethane prepolymer thoroughly mixed with 1 part of water by weight (50% prepolymer).
  - 2) A liquid prepolymer having a solids content of 82% to 88%, specific gravity of 1.1 (9.15 pounds per gallon), and flash point of 20°F.
  - 3) A liquid prepolymer having a viscosity of 300 to 500 centipoise at 72°F that can be pumped through 500 feet of 1/2-inch hose with a 500 psi head at a 1 ounce/second flow rate.
  - 4) 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.
  - 5) A cure time of 15 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.
  - 6) During injection; foaming, expansion, and viscosity increase take place.
  - 7) 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.
- f. Urethane base gel chemical sealing material requirements, properties, and characteristics:
- 1) 1 part urethane prepolymer thoroughly mixed with between 5 and 10 parts of water by weight. The recommended mix ratio is 1 part urethane prepolymer to 8 parts of water (11% prepolymer).
  - 2) A liquid prepolymer having a solids content of 77% to 83%, specific gravity of 1.04 (8.65 pounds per gallon), and flash point of 20°F.
  - 3) A liquid prepolymer having a viscosity of 600 to 1200 centipoise at 70°F that can be pumped through 500 feet of 1/2-inch hose with a 1000 psi head at 1 ounce/second flow rate.
  - 4) The water used to react with the prepolymer should be in the pH range of 5 to 9.



- 5) A cure time of 80 seconds at 40°F, 55 seconds at 60°F, and 3 seconds at 80°F when 1 part prepolymer is reacted with 8 parts of water only. Higher water ratios give longer cure times.
- 6) A cure time that can be reduced 5 to 10 seconds for water temperatures of 40°F to 80°F when 1 part prepolymer is reacted with 8 parts of water containing gel control agent.
- 7) A relatively rapid viscosity increase of the prepolymer/water mix. Viscosity increases from about 10 to 60 centipoise in the first minute for 1 to 8 prepolymer/water ratio at 50°F.
- 8) A reaction (curing) which produces a chemically stable, nonbiodegradable, tough, flexible gel.
- 9) The ability to increase mix viscosity, density, gel strength, and resistance to shrinkage by the use of additives to the water.

4. Monolithic Manhole Liners

When directed by the Department of Public Works, the Contractor shall install one of the following materials in manholes. The use of each of these methods is based upon the integrity of the manhole and the method will be as directed by the Department of Public Works.

- a. Permaform: This is an internal forming system for placing new concrete 3-inches thick within the existing manhole structure, upon with a plastic liner is cast integrally onto the surface of the new concrete. This will form an impermeable barrier for corrosion protection of the manhole.

Concrete shall be Type I Portland cement mix with a 5/8" coarse aggregate producing a minimum 4,000 PSI compressive strength at full cure.

A high-strength, quick setting cement grout shall be used for positioning and sealing the form at the manhole base and for maintaining active flows.

- b. Sewpercoat: Made of 100% calcium aluminate cement , is pre-packaged fiber reinforced, high strength wet shotcrete material. This product does not contain crystalline silica. Sewpercoat shall be applied according to manufacturer's recommendations; the application thickness would be in 1/2"-3/4" lifts to reach the original manhole wall thickness + 1/8" for additional manhole protection.

Compressive Strength, 24 hours (ASTM C-109)	>5,500psi
Tensile Strength (ASTM C-496)	>900 psi

Flexural Strength, 24 hours (ASTM C-293)	>1,300 psi
Shrinkage, 24 hours (ASTM C-596) @ 90% relative humidity	<0.04 psi
Bond, Slant Shear (ASTM C-882)	>2,300 psi @ 28 days

Hydraulic cement to meet the following requirements:

Set time (ASTM C-191)	60 seconds
Sulfate resistance, Passed (ASTM C-86)	25 cycles/min.
Freeze-Thaw Resistance, Passed	62 cycles
Shrinkage/Expansion (ASTM C-157)	+0.02
Pull Out Strength, lbs. (ASTM C-234)	12,000 lbs.
(4# bar imbedded in 6 inches in a cement pocket of 1.5 in diameter)	

5. Polyethylene (PE) Pipe
  - a. PE sewer liner pipe and fittings shall be manufactured from a polyethylene compound conforming to ASTM D 1248 and meeting the materials requirements for Type III, Class C, Grade Category 5.
    - 1) Pipe made from this compound must have a long-term hydrostatic strength rating of 1600 psi or more, in accordance with ASTM D 2837.
    - 2) When the environmental stress crack resistance (ESCR) of the compound is measured in accordance with ASTM D 1693, Condition C, the compound shall withstand not less than 1,000 hours in 100% solution Igepal CO-630 at 1008F before reaching a 20% failure point (F20).
  - b. The liner pipe shall be manufactured in accordance with ASTM D 3035 or ASTM F 714.
  - c. Liner Pipe Dimensions: The outside diameter and minimum wall thickness shall conform to dimensions listed in Table I when measured in accordance with ASTM D 2122. Where construction difficulties prevent use of these pipe sizes, other sizes may be specified.

**TABLE I**  
(all dimensions are in inches)

<u>Size of Sewer</u>	<u>OD of Liner</u>	<u>Nominal OD</u>	<u>Minimum Wall Thickness</u>			
			<u>SDR 32.5</u>	<u>SDR 26</u>	<u>SDR 21</u>	<u>SDR 17</u>
4	3.500	3" IPS	---	---	.167	---
6	4.500	4" IPS	---	---	.214	---
6	5.375	5.375"	.165	.207	.256	.316
8	6.625	6" IPS	.204	.255	.315	.390
8	7.125	7.25"	.219	.274	.339	.419
10	8.625	8" IPS	.265	.332	.411	.507
12	10.75	10" IPS	.331	.413	.512	.632
15	12.75	12" IPS	.392	.490	.607	.750
15	13.38	13.380"	.412	.515	.637	.787
18	16.00	16" IPS	.492	.615	.762	.941
21	18.00	18" IPS	.554	.692	.857	1.059
21	18.70	18.700"	.575	.719	.890	1.100
24	22.00	22" IPS	.677	.846	1.048	1.294
27	24.00	24" IPS	.738	.923	1.143	1.305
30	28.00	28" IPS	.862	1.077	1.333	1.647
36	32.00	32" IPS	.985	1.231	1.524	1.882
42	36.00	36" IPS	1.108	1.385	1.714	---
42	40.00	40" IPS	1.231	1.538	---	---
48	40.00	40" IPS	1.231	1.538	---	---
48	42.00	42" IPS	1.292	1.615	---	---
54	48.00	48" IPS	1.477	1.846	---	---

NOTE: The wall thickness tolerance shall be within plus 12%. The Standard Dimension Ratio of the pipe to be used shall be as specified in the Special Provisions.

6. Reinforced Plastic Mortar (RPM) Pipe

Reinforced Plastic Mortar (RPM) Pipe for liner in existing sewers shall be manufactured in accordance with ASTM D 3262 or ASTM D 3754 as specified. The pipe shall be manufactured by first applying a liner over a solid surface steel mandrel. The liner shall contain a thermosetting polyester, selected for the intended service, and surfacing veil as reinforcement. No aggregate shall be used in the liner. After the liner is applied, circumferentially oriented continuous glass filaments shall be wound around the liner to provide hoop strength and longitudinally oriented filaments shall be added to provide axial strength. Silica sand-resin mortar shall be added to provide correct ring stiffness. Wall thickness shall remain essentially constant regardless of pressure class. The bell of the pipe shall be manufactured as an integral part of the pipe. The basis of design shall be long-term hydrostatic testing and regression analysis. Long-term hydrostatic testing shall be done in accordance

with procedures in ASTM D 2992. Circumferential tensile strengths shall be obtained in accordance with ASTM D 2290.

7. Cured-in-Place Pipe Liner

All materials and procedures used in the inversion process shall be the manufacturer's current standards.

- a. Resin: The thermosetting resin shall be specifically blended for use with the inversion process and be chemically stable and resistant to concentrations of acids, alkalis, and organics found in normal sewage unless indicated otherwise.
- b. The felt tubular material shall be lined on one side with a waterproof coating such as polyurethane or polyvinyl chloride (PVC), and fully impregnated with a liquid thermosetting resin as specified. The tubing shall be properly sized to the diameter and length of the sewer pipeline to be rehabilitated. The material thickness shall generally be a minimum of 0.236 inches with a tolerance of .0625 inch plus or minus. The nominal specified thickness for each pipe section shall be designated on the plans. The cured pipe material shall conform to the following minimum structural standards:

<u>Cured Pipe Material Test</u>	<u>Standard</u>	<u>Results</u>
Tensile Stress	ASTM D 638	3,000 psi
Flexural Stress	ASTM D 780	3,000 psi
Modulus of Elasticity	ASTM D 790	300,000 psi

8. Pipeline Replacement

Pipe shall be as specified in Section 02561.02.

9. Manhole Rehabilitation and Replacement

- a. Flexible plastic gaskets shall be as specified in Section 02562.02.
- b. Cast-in-place concrete shall be as specified in Section 03300, Mix Number as indicated on the Standard Details or the Plans.
- c. Precast concrete sections and grade rings shall be as specified in Section 03400. In addition to the requirements of Section 03400, materials need to be hydrogen sulfide resistant. HDPE grade rings shall be as required in Section 02562.

- d. Mortar for placing precast concrete grade rings shall be as specified in Section 04100.02.
- e. Brick for manhole inverts shall be sewer brick as specified in Section 04200.02.
- f. Manhole frames, covers, and steps shall be as specified in Section 05500.02. Covers shall be in accordance with the Standard Details.
- g. Waterproofing and bentonite for manhole exterior shall be as specified in Section 07130.02.
- h. Curing compound shall be as specified in Section 02562.02.

### 02565.03 EXECUTION

#### A. Manhole lining – existing manholes

- 1. Prior to application of Sewpercoat, Contractor to apply hydraulic cement compound such as Parsons Quick Plug, for example, to fill the manhole riser section joints and other large circumferential cracks.
- 2. Sewpercoat application shall be in accordance with the manufacturer's recommendations and as specified below.
  - a. Surface preparation - Provide brush-off abrasive blast cleaning to remove loose surface concrete and contaminants and provide "tooth" for good coating adhesion. Repair all interior surface imperfections with epoxy mortar in accordance with the manufacturer's recommendations. Remove all dust from surface to receive the interior coating. All concrete surfaces shall be dry.
  - b. Apply cementitious liner according to manufacturer's recommendations.

#### B. Sewer Pipe Cleaning

- 1. General

The intent of sewer pipe cleaning is to remove foreign materials from the sewer and restore the pipeline to a minimum of 95% of the original pipe diameter or cross-section as required for proper seating of internal pipe joint sealing packers or as required for installation of pipe liners. It is recognized there are some conditions such as broken pipe and major blockages that prevent cleaning from being accomplished or where additional damage would result if cleaning were attempted or continued. Should such conditions be encountered, the Contractor shall notify the Engineer of the location and nature of obstruction. The Engineer will evaluate the

obstruction and will direct the Contractor as to the amount and method to be used to clean those specific pipe sections if cleaning is determined by the Engineer to be feasible. If in the course of normal cleaning operations, damage results from preexisting and/or unforeseen conditions such as broken pipe, the Contractor will notify the Engineer of the location and nature of the damage. The Contractor will be required to make repairs at his cost only when the Engineer has determined the contractor was negligent in performance of his cleaning operations.

2. Cleaning Equipment

a. Hydraulically Propelled Equipment

- 1) Equipment used for gravity pipelines shall be of a movable dam type and be constructed in a way that a portion of the dam may be collapsed at any time during the cleaning operation to protect against flooding of the sewer. The movable dam shall be equal in diameter to the pipe being cleaned and provide a flexible scraper around the outer periphery to insure removal of grease.
- 2) Pressure pipelines may be cleaned by use of pipe pigs specifically designed for the condition, size, and type of pipe being cleaned.

b. High-Velocity Jet (Hydrocleaning) Equipment: All high-velocity sewer cleaning equipment shall be constructed for ease and safety of operation. The equipment shall have a selection of two or more high-velocity nozzles. The nozzles shall be capable of producing a scouring action from 15 to 45 degrees to the axis of the pipe for all size lines designated to be cleaned. Equipment shall also include a high-velocity gun for washing and scouring manhole walls, benches and inverts. The gun shall be capable of producing flows from a fine spray to a solid stream. The equipment shall carry its own water tank, auxiliary engines, pumps, and hose reel.

c. Mechanically Powered Equipment

- 1) Bucket machines shall be in pairs with sufficient power to perform the work in an efficient manner. Machines shall be belt operated or have an overload device. Machines with direct drive that could cause damage to the sewer will not be allowed.
- 2) Power rodding machines shall be either sectional or continuous rod type capable of holding a minimum of 750 feet of rod. The rod shall be fabricated of heat-treated steel.

3. Sewer Cleaning

The designated sewer manhole sections shall be cleaned using hydraulically propelled, high-velocity jet, or mechanically powered equipment. Selection of equipment used shall be based on the method indicated in the "Special Provisions" or at the time work commences where no specific method is indicated in the "Special Provisions". The equipment and methods selected shall be satisfactory to the Engineer. The equipment shall be capable of removing dirt, grease, rocks, sand, other materials and obstructions from the sewer lines and manholes. If cleaning an entire section cannot be successfully performed from one manhole, the equipment shall be set up on the other manhole and cleaning attempted again.

4. Root Removal

- a. Roots shall be removed in sections where root intrusion is a problem. Special attention should be used during the cleaning operation to assure almost complete removal of roots from pipe joints. Any roots, which could prevent seating of the packer, the insertion of a pipe liner, or proper application of chemical crack or joint sealants, shall be removed. Root removal techniques may include use of mechanical equipment such as rodding machines, bucket machines or winches using root cutters, and porcupines; equipment such as high-velocity jet cleaners; or chemical root treatment at the option of the Contractor and final approval of the County.
- b. To aid in removal of roots, manhole sections identified to have root intrusion may be subjected to a chemical root treatment with an approved herbicide. The application of herbicide to the roots shall be done in accordance with the manufacturer's recommendations in a manner as to preclude damage to surrounding vegetation or affecting any treatment processes at any water reclamation facility. Any damaged vegetation identified by the Engineer shall be replaced by the Contractor at no additional cost to the County. All safety precautions recommended by the chemical manufacturer shall be observed by the Contractor during handling and application of the herbicide. Please note: application of chemical root treatment shall not occur within 5,000 linear feet, as measured along the pipe alignment, of a County Water Reclamation Facility (WRF).

5. Material Removal

All sludge, dirt, sand, rocks, grease, and other solid or semisolid material resulting from the cleaning operation shall be removed at the downstream manhole of the section being cleaned. Passing of material from manhole section to manhole section, which could cause line stoppages, accumulations of sand in wet wells, or damage to pumping equipment, will not be permitted.

6. Force Main Cleaning

Force mains shall be cleaned using hydraulically propelled or mechanically powered equipment. Hydraulically propelled pigs shall be inserted into the force main at designated locations or at other approved locations. Mechanically pulled scrapers may be used when conditions warrant. Equipment selected shall be capable of removing dirt, grease, sand, and other materials and obstructions from the lines.

7. Disposal of Materials

All solids or semisolids resulting from the cleaning operations shall be removed from the site transported in watertight vehicles, and disposed of at an approved disposal facility site obtained by the Contractor. All materials shall be removed from the site, transported in watertight vehicles, no less often than at the end of each workday. Under NO circumstances will the Contractor be allowed to accumulate debris, etc., on the site of work beyond the stated time, except in totally enclosed containers approved by the County.

C. Sewer Flow Control

1. Flow Reduction

When sewer line depth of flow at the upstream manhole of the manhole section being worked is above the maximum allowable for television inspection, joint testing, and/or sealing; the flow shall be reduced to the level indicated below by operation of pumping stations, plugging or blocking of flow, or by pumping and bypassing of flow as required.

2. Depth of Flow

Depth of flow shall not exceed that indicated below for the respective pipe sizes as measured in the manhole when performing television inspection, joint testing, and/or sealing.

a. Maximum depth of flow for television inspection:

- 6" - 10" Pipe.....20% of pipe diameter
- 12" - 24" Pipe.....25% of pipe diameter
- 27" & up Pipe.....30% of pipe diameter

b. Maximum depth of flow for joint testing/sealing:

- 6" - 12" Pipe.....25% of pipe diameter
- 15" - 24" Pipe.....30% of pipe diameter
- 27" & up Pipe.....35% of pipe diameter

3. Plugging or Blocking



A sewer line plug shall be inserted into the line upstream of the manhole section being worked. The plug shall be so designed that all or any portion of the sewage can be released. During TV inspection, testing, and sealing operations, flow shall be reduced to within limits specified above. After the work has been completed, flow shall be restored to normal.

4. Pumping and Bypassing

When pumping and bypassing is required, the Contractor shall furnish temporary pumps, conduits, and other equipment to divert the flow of sewage around the manhole section in which work is to be performed. The bypass system shall be of sufficient capacity to transport existing flow plus additional flow that may occur during a rainstorm. The Contractor will be responsible for furnishing the necessary labor and supervision to set up, operate the pumping and bypassing system and man the bypassing operation on a 24-hour, 7-day per week basis until bypass operations are completed. Pump engines shall be equipped with exhaust silencers and/or enclosures to keep noise to a minimum. The system shall be so constructed as to prevent spills from leaving the immediate vicinity of the site. Any spillage that occurs shall be immediately cleaned up and the site returned to a clean sanitary condition. Bypassing plans to be reviewed and approved by County prior to setup. County Utility Operations to be prior notified of extent of bypassing operations.

5. Flow Control Precautions

When flow in a sewer line is plugged, blocked, or bypassed; sufficient precautions must be taken to protect the sewer lines from damage that might result from sewer surcharging. In addition, precautions must be taken to insure that sewer flow control operations do not cause flooding or damage to public or private property being served by the sewers involved.

**D. Television Inspection**

1. Pipe designated for inspection shall be examined by closed circuit television techniques.
2. Before visual inspection, the pipe shall be cleaned as specified in Section 02565.03, "Sewer Pipe Cleaning".
3. The inspection will be done one pipeline section (between two manholes) at a time. The flow in the section being inspected will be controlled as specified in Section 02565.03, "Sewer Flow Control".
4. The television camera used for inspection shall be specifically designed and constructed for such inspection. Lighting for the camera shall be sufficient to allow a clear picture of the entire periphery of the pipe. The camera shall be operative in 100% humidity conditions. The camera, television monitor, and other components of

the video system shall be capable of producing a picture quality satisfactory to the Engineer. Unsatisfactory equipment shall be removed and no payment will be made for an unsatisfactory inspection.

5. The camera shall be moved through the pipeline in either direction at a moderate rate, stopping and panning when necessary to permit proper documentation of the sewer's condition and at every house connection from which flow is evident. The camera shall remain at that location until the flow from the connection stops or until the sources of the flow has been determined. In no case will the television camera be pulled at a speed greater than 30 feet per minute. Manual winches, power winches, TV cable, and powered rewinds or other devices that do not obstruct the camera view or interfere with proper documentation of the sewer conditions shall be used to move the camera through the sewer line. If, during the inspection operation, the television camera will not pass through the entire pipe section, the Contractor shall reset his equipment so the inspection can be performed from the opposite manhole. If, again, the camera fails to traverse the entire pipe section, the Engineer shall determine if the pipe is obstructed and if the Engineer determines the pipe is obstructed, the inspection work shall be considered complete, the pipe designated as obstructed, and no further inspection work will be required in that pipeline section.
6. When manually operated winches are used to pull the television camera through the line, suitable means of communications shall be set up between the two manholes of the section being inspected to insure good communications between members of the crew.
7. The importance of accurate distance measurements is emphasized. Measurement for location of defects shall be made above ground by a meter device. Marking on the cable, or the like, which would require interpolation for depth of manhole, will not be permitted. Accuracy of the distance meter shall be checked by use of a walking meter, roll-a-tape, or other suitable device before beginning the inspection work.
8. Documentation of the television results shall be as follows:
  - a. Television Inspection Logs: Inspection logs to be provided both as hard copies in a binder, and electronically, in PDF format. One copy of typed location records shall be prepared from field inspection logs maintained by the Contractor which clearly indicate the location, in relation to an adjacent manhole, of each infiltration point and its estimated quantity of leakage observed during inspection. In addition, other points of significance such as locations of building sewers, unusual conditions, roots, storm sewer connections, broken pipe, obstructions, presence of scale and corrosion, and other discernible features will be recorded.
  - b. Photographs: Digital photos, instant developing, 35 mm, or other standard-size photographs of the television picture of problems shall be taken by the

Contractor, and furnished the County as a part of the Inspection Logs. Digital images shall be provided as hard copy and on a CD.

c. Videotape Recordings:

- 1) The videotaped recording shall be transferred to DVD format for viewing on either a computer or on a TV. DVDs to be supplied in a hard sleeve; DVD to be labeled with date, time, manhole reach (MH# to MH#). Contractor to use County manhole numbering.
- 2) The purpose of tape recording is to supply a visual and audio record of the entire length of pipeline inspected. Videotaped recording playback shall be at the same speed as recorded. Slow motion or stop-motion playback features may be supplied at the option of the Contractor. Title to the tape shall remain with the Contractor; however, the County shall be provided a copy of all tapes/DVDs at the completion of the project as part of inspection documentation. The Contractor shall have all videotapes and necessary playback equipment readily accessible for review by the County during the project until a record copy has been made, after which time the tapes may be erased at the Contractor's option.
- 3) Defects shall be documented and quantified verbally by the audio portion of the videotapes by the Contractor as well as in the written inspection logs. Approximate stationing shall be shown on the screen and will be reflected in the inspection log.
- 4) The DVDs will be reviewed by the Engineer for focus, lighting, clarity of view, and technical quality. The Contractor shall maintain sharp focus, proper lightening, and clear, distortion free viewing during the camera operations. Failure to maintain these conditions will result in rejection of the videotape by the Engineer. Any videotape not acceptable to the Engineer will be retelevised at no expense to the County.
- 5) The County has standardized on the NASSCO's PACP program for pipe evaluation. The Contractor must use PACP protocols and standards for the pipe inspection. Contractor to provide proof of NASSCO certification in PACP and at least five (5) years of experience in closed-circuit television sewer and manhole inspection.

**E. Sewer Pipe Joint Testing**

1. Before pipe joint testing, the pipe section to be tested shall be cleaned as specified in Section 02565.03, "Sewer Pipe Cleaning".
2. Before starting the pipe joint testing phase of the work, a two-part control test shall be performed as follows:
  - a. To insure accuracy, integrity, and performance capabilities of the testing equipment, a demonstration test shall be performed in a test cylinder constructed in a manner that a minimum of two known leak sizes can be simulated. This technique will establish test equipment performance capability in relationship to the test criteria and insure there is no leakage of the test medium from the system or other equipment defects that could affect the joint testing results. If this test cannot be performed successfully, the Contractor shall repair or otherwise modify his equipment and re-perform the test until the results are satisfactory to the Engineer. This test may be required at any other time during the joint testing work, if the Engineer suspects the testing equipment is not functioning properly.
  - b. After entering each manhole section with the test equipment, but before commencement of joint testing, the test equipment shall be positioned on a section of sound sewer pipe between pipe joints, and a test performed as specified. This procedure will demonstrate reliability of the test requirement, as no joint will test in excess of the pipe capability. Should the barrel of the sewer pipe not meet the joint test requirements, the requirements may be modified as necessary.
3. Pipe joint testing will be performed on a pipe section (between two manholes) basis.
4. The Contractor shall control flow in the pipe section undergoing crack and joint sealing in accordance with Section 02565.03, Article B, "Sewer Flow Control".
5. Sewer pipe joints visibly leaking will not require pressure testing but shall be classified as defective and designated for repair. Each sewer pipe joint not visibly leaking shall be individually tested at a test pressure equal to 0.5 psi per vertical foot of pipe depth below the ground surface plus 1 to 2 psi (not exceeding a test pressure of 10 psi) in accordance with one of the following procedures:
  - a. Liquid Test Procedure
    - 1) The testing device shall be positioned within the pipeline in a manner to straddle the pipe joint to be tested.
    - 2) The testing device ends (end elements, sleeves) shall be expanded to isolate the joint from the remainder of the line and create a void area

between the testing device and pipe joint. The ends of the testing device shall be expanded against the pipe with sufficient pressure to contain a minimum of 10 psi within the void without leakage past the expanded ends.

- 3) Water or an equivalent liquid shall then be introduced into the void area until a pressure equal to or greater than the required test pressure is observed by the void pressure monitoring equipment. If the required test pressure cannot be developed (due to joint leakage), the joint will fail the test and will be classified as defective.
- 4) The flow rate of the test liquid shall then be regulated to a rate at which the void area pressure is observed to be the required test pressure. A reading of the test liquid flow meter shall then be taken. If the flow rate exceeds 1/4 gallon per minute (due to joint leakage), the joint will fail the test and will be classified as defective and designated for repair.

b. Air Test Procedure

- 1) The testing device shall be positioned within the line in a manner to straddle the pipe joint to be tested.
  - 2) The testing device ends (end elements, sleeves) shall be expanded to isolate the joint from the remainder of the line and create a void area between the testing device and pipe joint. The ends of the testing device shall be expanded against the pipe with sufficient pressure to contain a minimum of 10 psi or the test pressure whichever is greater within the void without leakage past the expanded ends.
  - 3) Air 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 (due to joint leakage), the joint will fail the test and will be classified as defective and designated for repair.
  - 4) After the void area pressure is observed to be equal to or greater than the required test pressure, the airflow shall be stopped and a 5 second stabilization period shall commence. If the void area pressure decays by more than 0.5 psi within 20 seconds (due to joint leakage), the joint will fail the test and will be classified as defective and designated for repair.
6. During the joint testing work, records shall be maintained by the Contractor which indicate:

Identification of the pipe section tested;

Test method used;

Test pressure used;

Location (footage) of each joint tested;

A statement indicating the test results (passed or failed) for each joint tested.

**F. Sewer Pipe Joint Sealing**

1. General

The intent of sewer pipe joint sealing work is to seal sewer pipe joints, which have been designated as defective using the internal joint sealing method. It is recognized this method may only be used on sewer pipe sections in sound physical condition. Longitudinally cracked or broken pipe will not be sealed. When bell cracks or chips are evident from pipe section offset, sealing may be undertaken where the offset is small enough to allow proper seating of the sealing packer on both sides of the joint to be sealed.