

## SECTION 33 01 12 – SEWER FLOW CONTROL

### PART 1 -- GENERAL

#### 1.1 THE SUMMARY

- A. The objective of flow bypass and/or diversion pumping (SEWER FLOW CONTROL) is to:
1. Maintain an efficient and uninterrupted level of service to wastewater collection system users while maintenance or construction operations (including rehabilitation, repair or replacement) are facilitated on the segment or segments being bypassed and/or from which flow is being diverted within the wastewater collection system.
  2. Ensure all levels of sewage flow are continuously and effectively handled around the segment or segments of sewer being bypassed and/or from which flow is being diverted.

B. Related sections:

1. Section 31 23 33 – Trenching and Backfilling
2. Section 33 01 30.61 – Sewer and Pipe Joint Sealing
3. Section 33 01 30.41 – Cleaning of Sewers
4. Section 33 01 30.16 – TV Inspection of Gravity Pipelines
5. Section 33 01 30.72 – Relining Sewers
6. Section 33 01 30.71 – Rehabilitation of Sewer Utilites

#### 1.2 PERFORMANCE REQUIREMENTS

- A. It is essential to the operation of the existing sewerage system that there is no interruption in the flow of sewage throughout the duration of the project. To this end, the CONTRACTOR shall provide, maintain and operate all temporary facilities such as dams, plugs, pumping equipment (both primary and back-up units as required), conduits, all necessary power, and all other labor and equipment necessary to intercept the sewage flow before it reaches the point where it would interfere with his/her WORK, carry it past his/her WORK, and return it to the existing sewer downstream of his/her WORK.
- B. The design, installation and operation of the temporary pumping system shall be the CONTRACTOR's responsibility. The bypass system shall be the CONTRACTOR's responsibility. The bypass system shall meet the requirements of all codes and regulatory agencies having jurisdiction.
- C. The CONTRACTOR shall provide all necessary means to safely convey the sewage past the WORK area.
- D. The CONTRACTOR shall maintain sewer flow around the work area in a manner that will not cause surcharging sewers or damage to sewers, and that will protect public and private property from damage and flooding.

- E. The CONTRACTOR shall protect water resources wetlands and other natural resources.
- F. In the event of a bypass failure, the CONTRACTOR shall be responsible for all necessary corrective action, as approved by the OWNER, to complete the original assignment.
- G. The CONTRACTOR shall be solely responsible for planning and executing sewer flow control, bypass and diversion pumping operations. The CONTRACTOR shall be entirely liable for damages to private or public property that may result from his operations and for all cleanup, disinfection, damages, and resultant fines in the event of spillage, flooding or overflow.

## **PART 2 -- PRODUCTS (NOT USED)**

## **PART 3 -- EXECUTION**

### **3.1 CONSTRUCTION**

- A. All WORK and testing shall comply with the applicable Federal codes, including Federal Occupational Safety and Health Act of 1970 and the Construction Safety Act of 1969, as amended, and applicable State and local codes and standards; and to the extent applicable with the requirements of the Underwriter's Laboratories, Inc. and the National Electric Code.
- B. If during normal rehabilitation work on manholes and sewers, where flow control devices, including flow bypass and diversion pumping, have not been deployed, wastewater flow depth exceeds the workable levels, rehabilitation work shall be immediately discontinued. Rehabilitation works shall only resume, at no extra cost to the OWNER when minimum flow levels prevail.
- C. During all bypass-pumping or other flow control operations, the CONTRACTOR shall prevent mains, manholes, and all local sewer lines from damage inflicted by any equipment. The CONTRACTOR shall be responsible for all physical damage to mains, manholes, and all local sewer lines caused by human or mechanical failure.
- D. The CONTRACTOR shall coordinate with the OWNER as necessary to determine and effect optimum working arrangements.
- E. The CONTRACTOR shall immediately cease bypass and/or diversion pumping when so ordered by the OWNER.
- F. The CONTRACTOR shall notify the OWNER 24 hours prior to commencing actual flow bypass and/or diversion pumping operations. The CONTRACTOR flow control proposal shall be agreed to by the OWNER before the CONTRACTOR shall be allowed to commence sewerage bypass pumping and/or diversion.

### **3.2 FIELD QUALITY CONTROL**

- A. During flow bypass and/or diversion pumping, the CONTRACTOR is prohibited from allowing any sewage to be dumped, or spilled in or onto the ground or any area outside of the existing wastewater collection system. In addition, due care and attention shall be given to prevent vehicular or pump fuel or lubrication oil to be leaked.

- B. When flow bypass and diversion pumping operations are complete, the residual contents of sewage in piping shall be drained into the existing sewer prior to disassembly.
- C. It shall be the responsibility of the CONTRACTOR to schedule and perform his/her work in a manner that does not cause or contribute to incidence of overflows or spills of sewage from the sewer system.
- D. In the event that the CONTRACTOR work activities contribute to overflows or spills the CONTRACTOR shall immediately take appropriate action to contain and stop the overflow, clean up the spillage, disinfect the area affected by the spill, and notify the OWNER in a timely manner.
- E. CONTRACTOR will indemnify and hold harmless the OWNER for any fines or third-party claims for personal or property damage arising out of a spill or overflow that is fully or partially the responsibility of the CONTRACTOR, including the legal, engineering and administrative expenses of the OWNER in defending such fines and claims.

END OF SECTION

## **SECTION 33 01 30.13 – SEWER AND MANHOLE TESTING**

### **PART 1 – GENERAL**

#### **1.1 THE SUMMARY**

- A. Perform all pipeline flushing, testing and inspection, complete for sanitary sewer system piping as specified herein and in accordance with the requirements of the Contract Documents.
- B. The responsibility for conveying, using and disposing of water from the OWNER-designated source to the point of usage for cleaning and testing operations is the CONTRACTOR's.

#### **1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS**

- A. APWA / AGC Standard Specifications for Public Works Construction, latest edition.

#### **1.3 CONTRACTOR SUBMITTALS**

- A. The CONTRACTOR shall provide a minimum 48-hour advance written notice of proposed testing schedules and testing procedures for review and concurrence of the ENGINEER. The CONTRACTOR's proposed plans for water conveyance, control, and disposal shall also be submitted in writing.
- B. Submittals required herein shall be in accordance with Section 01 33 00 – Submittal Procedures.

### **PART 2 -- PRODUCTS**

#### **2.1 MATERIALS**

- A. Temporary valves, bulkheads, or other water control equipment and materials shall be as specified herein and/or as determined by the CONTRACTOR subject to the ENGINEER's review. No materials shall be used which would be injurious to pipeline structure and future function.

### **PART 3 – EXECUTION**

#### **3.1 CONSTRUCTION**

- A. Special Techniques:
  - 1. All testing shall be performed in the presence of the ENGINEER.
  - 2. Unless otherwise provided herein, water for testing and flushing will be furnished by the OWNER; however, the CONTRACTOR shall make all necessary provisions for conveying the water from the OWNER – designated source to the points of use.
  - 3. Where water from the OWNER is not available, the CONTRACTOR shall furnish water by tank truck or barrels.

4. Release of water from pipelines after testing has been completed shall be performed as reviewed by the ENGINEER.

### 3.2 FIELD QUALITY CONTROL

#### A. Inspection

1. Each sewer line between manholes, upon completion or at such time as the ENGINEER may direct, but prior to its being included for partial payment, is to be cleaned and visually inspected by "lamping". The sewer lines shall be free from cracked or broken pipe, dirt, debris and visible leakage and shall be true to line and grade within the specified tolerances. All defects shall be corrected promptly at the CONTRACTOR's expense.

#### B. Manhole Rehabilitation Field Testing

##### 1. Field Testing

- a. **Continuity Testing:** After the protective coating has set hard to the touch, it shall be inspected with high voltage holiday detection equipment. Surfaces shall first be dried. An induced holiday shall then be made on to the coated concrete surface and shall serve to determine the minimum/maximum voltage to be used to test the coating for holidays at that particular area. The spark tester shall be initially set at 100 volts per 1 mil (25 microns) of film thickness applied but may be adjusted as necessary to detect the induced holiday (refer to NACE RPO188-99). The cured polyurethane lining shall be spark tested for pinholes with a spark tester set at 15,000 volts minimum. All pinholes shall be repaired as specified. All detected holidays shall be marked and repaired in strict accordance with manufacturer's recommendations
- b. **Joint Integrity:** Welded joints shall have no visible cracks, separations, or unfused areas. The ENGINEER may check for separation and unfused areas by probing with a putty knife or similar semi-sharp flat object. Separations and unfused areas shall be repaired to the ENGINEER's satisfaction.

##### 2. Inspection and Testing Completed Manhole

- a. After manhole sealing or manhole rehabilitated has been completed the surface of the installed liner shall be cleaned and prepared to permit visual inspection. Visually inspect the manhole in the presence of the ENGINEER. Check for cleanliness and for elimination of active leaks.
- b. Assist ENGINEER in verifying installation of lining thickness and sounding. Test several points on the manhole wall. Areas damaged by sounding testing shall be repaired prior to final acceptance. The finished surface shall be free of blisters, "runs" or "sags" or other indications of uneven lining thickness. The liner will be applied to a minimum thickness of 250 mils. No evidence of visible leaks shall be allowed.
- c. In addition, at the OWNER's request, the CONTRACTOR may be required within five years to visually inspect the manholes that were rehabilitated. Any work that

has become defective within the five-year period shall be redone by the CONTRACTOR at no additional expense to the OWNER.

- d. Vacuum testing will be completed after two weeks cure time, and all defects shall be repaired as necessary.

**3. Manhole Testing**

- a. Rehabilitated manholes shall be tested per section 01 74 20 – Gravity Pipeline Testing
- b. All costs for carrying out testing and all the foregoing requirements of this paragraph shall be at the CONTRACTOR's expense. Test results shall be confirmed in writing and submitted to the ENGINEER for review in compliance with Section 01 33 00 – Submittal Procedures.

**END OF SECTION**

## **SECTION 33 01 30.16 – TV INSPECTION OF GRAVITY PIPELINES**

### **PART 1 – GENERAL**

#### **1.1 THE REQUIREMENT**

- A. Furnish all necessary labor, materials, equipment, services and incidentals required to visually inspect, by means of closed-circuit television (CCTV), designated gravity pipelines up to 48 inches in diameter.**
- B. Furnish all necessary labor, materials, equipment, services and incidentals required to inspect gravity pipelines larger than 48 inches in diameter. These pipeline may alternatively be inspected by either by CCTV inspection or by direct entry of personnel, provided that the specified data is collected. The CONTRACTOR is responsible for compliance with applicable safety and regulatory requirements under either option.**
- C. Inspect one line segment at a time. The line segment being inspected shall be suitably flow isolated from the remainder of the gravity pipeline system.**
- D. Make accommodations for the Engineer to witness all inspections.**
- E. Sewers to be inspected shall be cleaned in accordance with Section 33 01 30.41 – Cleaning of Sewers prior to CCTV inspection.**
- F. Make video recordings of the television inspections on DVD. Supply copies of both the recordings and the Television Inspection Report at no cost to the Owner.**

#### **1.2 REFERENCE SPECIFICATIONS, CODES AND STANDARDS**

- 1. Section 00 31 13 – Construction Progress Schedule**
- 2. Section 01 33 00 – Submittal Procedures**
- 3. Section 01 35 29 – Health, Safety, and Emergency Response Procedures**
- 4. Section 33 01 12 – Sewer Flow Control**
- 5. Section 33 01 30.41 – Cleaning of Sewers**
- 6. Section 33 01 30.71 – Rehabilitation of Sewer Utilities**

#### **1.3 CONTRACTOR SUBMITTALS**

- A. Furnish Submittals in accordance with Section 01 33 00 – Submittal Procedures.**
- B. Contractor shall provide a schedule with the Work Authorizations (WAs) during the design phase and provide monthly updates. Contractor shall provide a "Primavera P6" Critical Path Method (CPM) schedule with the WA(s) during the construction phase and provide monthly updates. Contractor shall provide schedule in accordance with Section 01 31 13 – Project Coordination.**

- C. The Contractor will submit digital weekly and monthly progress reports that quantify progress on all aspects of the project.
- D. The Contractor shall deliver the CCTV inspection data and logs on DVDs or on an external hard drive at 10%, 70%, and 100%. The Contractor shall provide all video inspection results in electronic database format. This data shall be capable of being uploaded into the OWNER'S database without generating errors. The contractor shall make all required and/or requested modifications to the collected data to facilitate the data transfer. Contractor data that results in duplicate inspections or work order numbers in the OWNER'S database will not be allowed.
- E. Contractor shall also submit Pipeline Assessment Certification Program (PACP) database of inspections. The Contractor shall deliver 3 external hard drives that each contain the entire video inspection upon completion of the project.
- F. All CCTV operator(s) responsible for direct reporting of pipeline condition shall have a minimum of 3 years previous experience in surveying, processing, and interpretation of data associated with CCTV inspections and shall be certified under the NASSCO (National Association of Sewer Survey Companies) PACP (Pipe Line Assessment and Certification Program). The Contractor shall provide the Engineer with written documentation that all CCTV operators meet these experience requirements which shall include a list of projects undertaken as well as client name and telephone number for reference.

#### 1.4 FIELD SUPERVISION BY CONTRACTOR

- A. The Contractor shall maintain on site at all times a competent field supervisor in charge of the survey/inspection. The field supervisor shall be approved in writing by the Engineer prior to commencement of Work. Any change of supervision must also be approved in writing by the Engineer prior to the change. The field supervisor shall be responsible for the safety of all site workers and site conditions as well as ensuring that all work is conducted in conformance with these specifications and to the level of quality specified.

#### 1.5 OVERFLOWS AND SPILLS

- A. It shall be the responsibility of the Contractor to schedule and perform his/her work in a manner that does not cause or contribute to incidence of overflows or spills of sewage from the pipeline system.
- B. In the event that the Contractor work activities contribute to overflows or spills, the Contractor shall immediately take appropriate action to contain and stop the overflow, clean up the spillage, disinfect the area affected by the spill, and notify the Engineer in a timely manner in accordance with Section 01 35 29 – Health, Safety, and Emergency Response Procedures.
- C. Contractor will indemnify and hold harmless the County for any fines or third-party claims for personal or property damage arising out of a spill or overflow that is fully or partially the responsibility of the Contractor, including the legal, engineering and administrative expenses of the County in defending such fines and claims.



## 1.6 INSPECTION FORMS

- A. Post construction inspections of manholes, laterals and main gravity lines will adhere to the following criteria:
1. Mainline Video Inspections- Header and Inspection form will be completed as per the most recent version of National Association of Sewer Service Companies (NASSCO) Pipeline Assessment Certification Program (PACP). In addition to the required fields the following fields will be completed:
    - Field 2 - Owner
    - Field 4 - Drainage Area
    - Field 9 – Time / date
    - Field 29 - Total Length
    - Field 34 - Purpose
    - Field 37 - Weather
    - Field 41 – Project
  2. Lateral Video Inspections- Header and Inspection form will be completed as per the most recent version of NASSCO Lateral Assessment and Certification Program (LACP). In addition to the required fields the following fields will be completed:
    - Field 5 - Owner
    - Field 7 - Drainage Area
    - Field 12-Time
    - Field 17 - Upstream Manhole
    - Field 18- Downstream Manhole
- B. All NASSCO inspection forms and header will be exported using the PACP or LACP export option.

## 1.7 SAFETY

- A. The CONTRACTOR shall carry out his/her operations in a safe manner and in accordance with all applicable state and federal regulations.

## PART 2 – PRODUCTS

### 2.1 VIDEO EQUIPMENT

- A. Furnish the television inspection cameras, video capture equipment, and other necessary equipment, materials, electricity, labor, and technicians, needed to perform the television inspection.
- B. The television camera used for the gravity pipeline inspection shall be specifically designed and constructed for type of pipeline being inspected. The camera shall be waterproof and shall be operative in any conditions that may be encountered in the inspection environment. The camera shall be operative in 100% humidity conditions. The camera shall be a color pan and tilt camera to facilitate the inspection of service laterals and sewer line and manhole defects. The television camera shall be capable of 360 degree rotational scan indicating any salient defects. The tilt arc must not be less than

nominally 270 degrees unless otherwise agreed. The adjustment of focus and iris shall provide a minimum focal range from 6 inches in front of the camera's lens to infinity. The distance along the pipeline in focus from the initial point of observation shall be a minimum of twice the vertical height of the pipeline. The illumination must provide an even distribution of the light around the pipeline perimeter without flare out of picture, shadowing, or loss of image contrast. The view seen by the television camera shall be transmitted to a monitor with a screen size of at least eleven (11) inches. The television camera shall be capable of receiving and transmitting a picture having not less than 700 lines of resolution. The travel speed of the television inspection camera (through the pipeline) shall be uniform, and shall not exceed the maximum speed specified herein or as directed by the Engineer. The CONTRACTOR shall maintain camera in clear focus at all times. Picture quality and definition shall be to the satisfaction of the OWNER; and if unsatisfactory, equipment shall be removed and replaced with adequate equipment at no additional cost to the OWNER.

- C. The video camera shall include a title feature capable of showing on the tape the following information:
1. City and State
  2. Date/Time
  3. CONTRACTOR's Name
  4. Line Size, Material, and Depth .
  5. Manhole Identification (both manholes)
  6. On-going Footage Counter
- D. The television equipment shall be transported in a stable condition through the pipeline under inspection. Throughout the inspection, the camera equipment shall be positioned with the camera directed along the longitudinal axis of the pipeline. The television camera shall advance through the pipeline at a maximum speed of 30 feet per minute. Make all efforts to prevent damage to the pipeline during the television inspection. In the case where damage is caused by the Contractor, for any reason, such as would be caused by retrieval of lodged equipment, the cost of repair or remedy shall be made by the Contractor at no expense to the Local Public Agency.
- E. Provide all the material and equipment necessary to divert wastewater flow if needed in accordance with Section 33 01 12 – Sewer Flow Control. Observed flow depths noted during an initial CCTV inspection of the Project are noted in the Special Attachments.
- F. The Contractor shall test the television inspection equipment to verify the picture quality. The equipment manufacturer's recommendation shall be used to clearly differentiate between the following colors: white, yellow, cyan, green, magenta, red, blue, and black. Certification that this test has been conducted must be submitted to the Engineer.
- G. The television inspection equipment shall be of such high quality as to enable the following to be achieved:

1. **Color:** With the monitor adjusted for correct saturation, the six colors plus black and white shall be clearly resolved with the primary and complementary colors in order of decreasing luminance.
2. **Linearity:** The background grid shall show squares of equal size, without convergence/divergence over the whole picture. The center circle shall appear round and have the correct height/width relationship ( $\pm 5\%$ ).
3. **Resolution:** The live picture must be displayed on a monitor capable of providing a clear, stable image free of electrical interference with a minimum horizontal resolution not less than 700 lines.
4. **Color Consistency:** To ensure the camera shall provide similar results when used with its own illumination source, the lighting shall be fixed in intensity prior to commencing the survey. In order to ensure color consistency, no variation in illumination shall generally take place during the survey, except for the viewing of service/lateral lines.

The Contractor shall note that the Engineer may periodically check both the live and video picture color consistency against the color bar. Any differences will necessitate re-survey of the new length or lengths affected, at the Contractor's expense.

- H. The Engineer may periodically check both the live and recorded picture for image quality. Any deficiencies will necessitate the Contractor re-survey the line segments affected, at the Contractor's expense. Video DVDs displaying poor video quality will be deemed unacceptable and no payments will be made until lines are retelevised and a new DVD is submitted. Poor video quality refers to, but is not limited to, the following: grease or debris on the lens, camera under water, picture too dark, excessive camera speed through the line, lines improperly cleaned, poor/no audio, etc.
- I. The CCTV monitor display shall incorporate an automatically updated record in feet and tenths of a foot of the distance along the line from the cable calibration point to the center point of the camera. The Contractor shall use a suitable metering device that enables the cable length to be accurately measured, accurate to plus or minus 2 percent. The Contractor shall demonstrate that the tolerance is being complied with, by tape measurement between manholes on the surface. This taped measurement shall be included on each television inspection log, both written and digital.
- J. If the Contractor fails to meet the required standard of accuracy, the Engineer shall instruct the Contractor to provide a new device to measure the footage. The Engineer may at his/her discretion instruct the Contractor, in writing, to re-survey those lengths of pipeline first inspected with the original measuring device using the new measuring device at no additional cost to OWNER.

## 2.2 VIDEO INSPECTION VEHICLE

- A. The television inspection vehicle shall be large enough to accommodate four (4) people for the purpose of viewing the television monitor while the inspection is in progress. The television inspection vehicle shall be insulated against noise and extremes in temperature, and shall be provided with means of controlling external and internal sources of light in a manner capable of ensuring that the monitor screen display is in accordance with the

Specifications. The Engineer or his/her representative shall have access to view the television screen at all times. The central control panel and television camera control shall be located in the mobile television inspection vehicle. The television inspection camera shall be mounted on a mobile vehicle (truck or trailer), which allows safe and orderly movement of the inspection equipment throughout the Site.

### **PART 3 -- EXECUTION**

#### **3.1 EXAMINATION**

- A. Do not begin cleaning until both upstream and downstream manholes have been checked for flow monitors and other mechanical devices. Refer to Section 33 01 30.71 - Rehabilitation of Sewer Utilities.

#### **3.2 CLEANING**

- A. Sewers to be inspected shall be cleaned in accordance with Section 33 01 30.41 - Cleaning of Sewers.
- B. Sewer cleaning shall be completed prior to CCTV inspection of each sewer segment.

#### **3.3 TELEVISION INSPECTION - PRECONSTRUCTION SURVEY**

- A. Prior to any repair work, the entire pipeline (from manhole to manhole) shall be televised. The camera shall be placed at the center of the manhole and videotaping shall commence prior to entering the pipe. The CONTRACTOR shall show the inside of the manhole walls and the pipe connection to the wall at both the upstream and downstream manhole.
- B. The camera shall be moved through the line in either direction at a moderate rate, stopping when necessary to permit proper documentation of the pipeline's condition. In no case shall the television camera be pulled at a speed greater than 30 feet per minute. Manual winches, power winches, TV cable, powered rewinds and tractors or other devices that do not obstruct the camera view or interfere with proper documentation of the pipeline conditions shall be used to move the camera through the pipeline. If the camera is being pulled through the pipeline by a hydraulic cleaning unit hose the cleaning nozzle shall be located a minimum of eight (8) feet away from the camera to allow a clear, unobstructed view. Jet nozzle shall be used in front of camera while televising through a dip to draft out water. If, during the survey operation, the television camera will not pass through the entire manhole section, the CONTRACTOR shall set up his equipment so that the survey can be performed from the opposite manhole.
- C. Whenever non-remote powered and controlled winches are used to pull the television camera through the line, telephones or other suitable means of communication shall be set up between the two manholes of the section being surveyed to insure good communications between members of the crew.
- D. Measurement for location of defects shall be above ground by means of a meter device. Marking on the cable, or the like, which would require interpolation for depth of manhole, will not be allowed. Measurement meters shall be accurate to tenths of a foot over the length of the section being surveyed. Accuracy of the distance meter shall be checked by

use of a walking meter, roll-a-tape, electronic distance meter or other suitable device. Manhole numbers and linear footage shall be shown on screen during taping.

- E. Movement of the television camera shall be temporarily halted for a minimum of ten seconds at each visible point source of infiltration and/or inflow until the leakage rate from that source is quantified. The camera shall be stopped at all service connections and the service lateral shall be inspected with the pan and tilt camera. The camera shall also be stopped at active service connections where flow is discharging. If the discharge persists, the property involved shall be checked to determine whether or not the discharge is sewage. If no flows are being discharged from the building, it shall be considered that the observed flow is infiltration/inflow.
- F. If television inspection of an entire line segment cannot be successfully completed from one manhole, a reverse set-up must be performed to obtain a complete television inspection. Contractor shall use the Reverse inspection function of Granite NET to record such inspections.
- G. The Contractor must use the latest PACP coding and PACP Databases. The Contracting Firm must use NASSCO Certified Operators to perform all pipeline inspections and must use PACP (V6.0 or Higher) Coding on all pipeline inspections. The pipe information for which inspection codes will be entered includes but is not limited to roots, cracks, offset joints, grease build up, debris build up, sags, pipe type, and lateral connections along with any pertinent information gathered during the pipeline inspections. The Contracting Firm shall calculate scores for all inspected pipe segments and submit data that includes PACP Scoring.
- H. Provide dewatering as needed to meet the requirements outlined in Section 33 01 12 - Sewer Flow Control.

### 3.4 DEPTH OF FLOW

- A. When sewage depth of flow at the upstream manhole of a pipe segment is above the maximum depth of flow for television inspection, the flow shall be reduced to the level shown below by specified flow control methods. Flows above the maximum shall be pumped or otherwise diverted in accordance with Section 33 01 12 - Sewer Flow Control.
- B. Depth of flow, measured in the upstream manhole, shall not exceed 20% of pipe height.
- C. There shall be no flow in pipelines being televised to verify cleaning prior to cured-in-place liner installation.

### 3.5 VIDEO RECORDING

- A. Provide continuous video recordings of the inspection view as it appears on the television monitor. The CONTRACTOR shall provide a video recording of the complete television inspection of all the pipelines included as part of this Project. Recording shall be on reproducible DVD's. The video recording shall reproduce clearly discernable sound and video information on the television monitor. The recording shall be free of interference and shall produce a clear, stable image. Slow motion or stop motion playback features shall be supplied by the CONTRACTOR. Once recorded, the DVD becomes property of

the OWNER. The CONTRACTOR shall have all DVD and necessary playback equipment readily accessible for review by the OWNER during the Project.

- B. The audio portion of the recording shall be clear and complete, and easily discernible. The audio portion shall state the following: "(Contractor's Name) is performing a pre/post TV survey for Job No. \_\_\_\_\_ (provided by the OWNER)". State date, time, operator's name, area, upstream manhole number to downstream manhole number, pipe size and material, upstream manhole depth, and TV survey will be from up- to downstream, or down- to upstream. The audio portion shall record and identify all visible defects and include the information required in conjunction with the NASSCO's PACP Standards, or other standards approved by Engineer. At the end of each line, state: "End of line", upstream manhole number to downstream manhole number, and total linear footage.
- C. The video recording equipment shall be continuously connected to the television inspection and monitoring equipment. The recording and monitoring equipment shall have the built-in capability to allow the Engineer and the Contractor to instantly evaluate both the audio and video quality of the recording at all times during the television survey.
- D. Two permanent labels are required on each DVD. One label shall be placed on the DVD case and the other on the face of the DVD. Recording of a single line segment shall not span more than one DVD. The recording of a segment between manholes shall be continuous and complete. The DVD's become the property of the Owner, once submitted. The Contractor shall maintain a master copy of all DVD's and associated Television Inspection Reports for one year after final acceptance by the Owner.
- E. Only line segments from this Project shall be included on the DVD's.
- F. Provide one (1) complete set of DVD's and inspection logs to the Owner.

### 3.6 TELEVISION INSPECTION REPORTS

- A. Television Inspection Forms (Survey Logs): Printed and electronically stored location records shall be kept by the CONTRACTOR and will clearly show the location in relation to an adjacent manhole of each infiltration point observed during survey. Upstream footage at face of manhole (0) and downstream footage at face of manhole (e.g., 250) shall be shown on the log. The television inspection forms to be utilized by the CONTRACTOR shall be those mandated by NASSCO's PACP. Both the "Header" and "Details" information of the form shall be entered as indicated in the PACP standards. The survey logs shall include, but not be limited to the following information:
  - 1. Correct pipe segment/manhole numbers
  - 2. Correct address of manhole location
  - 3. Manhole Diameter
  - 4. Pipe size, length and material
  - 5. Manhole depth (up and downstream)

6. UAZ (Utilities Analysis Zone) number
7. Lift station service area number
8. CD number and index
9. Footage locations, descriptions and estimated leak rates for visible point sources of infiltration inflow
10. Footage locations and descriptions of structural defects such as obstructions, any remaining root intrusion, offset joints, cracked pipe, fractured pipe, holes, collapses, sags, protruding service connections and/or blockages in the pipe.

The terminology to be used shall follow NASSCO's PACP standards. All information will be recorded and a copy of such electronic records and a hard copy will be supplied to the OWNER.

- B. Photographs: Digital photographs of the television picture of problems shall be taken by the CONTRACTOR upon request of the OWNER.

### 3.7 TELEVISION INSPECTION – POST CONSTRUCTION SURVEY

- A. Perform post-installation television inspection to confirm completion of rehabilitation work, including removal and replacement. Verify that rehabilitation work conforms to the requirements of the Drawings and Specifications. Provide a color videotape showing the completed work, including the condition of restored service connections. Prepare and submit Television Inspection Report forms providing location of service connections along with location of any discrepancies. Post-installation videotape of completed manholes may be substituted for photographic documentation, as described in Section 33 01 30.71 - Rehabilitation of Sewer Utilities. Manhole work, including benches, inverts and pipe penetrations into manhole, should be complete prior to post-installation videotape work.
- B. The post lining CCTV inspections shall be completed in the same electronic format as preconstruction CCTV and completed by an OWNER approved CCTV contractor.
- C. The same procedures shall be used as indicated in Section 3.3 - TELEVISION INSPECTION - PRECONSTRUCTION SURVEY.
- D. In addition, the CONTRACTOR shall stop camera at all point repairs, sectional repairs, and reinstated laterals, and inspect entire repaired pipe section.
- E. The CONTRACTOR shall invert white foreground to black as needed in the line section with light background.
- F. In the case of a post-liner survey, the CONTRACTOR shall fully televise both ends of the liner at the manhole so that the fit of the liner to the host pipe can be evaluated. The CONTRACTOR shall take as many photographs as possible of a given liner (where video recording is difficult or not clear) by physically turning the camera around to film the liner end, so that the camera is facing back in the direction it just traversed, to ensure adequate and complete photographs.
- G. The post-liner television survey shall be done within 2 weeks of liner installation.

H. The same documentation shall be provided as indicated in Section 3.5 – VIDEO RECORDING and Section 3.6 - TELEVISION INSPECTION REPORTS

- END OF SECTION -



## **SECTION 33 01 30.41 – CLEANING OF SEWERS**

### **PART 1 – GENERAL**

#### **1.1 THE SUMMARY**

- A. Furnish all labor, materials, equipment and incidentals required to clean all sewer pipe and fittings installed and/or rehabilitated, complete as directed by the OWNER and as specified herein.**
- B. Cleaning shall include the proper high pressure water jetting, rodding, bucketing, brushing and flushing of sewers and manholes prior to inspection by closed circuit television, pipeline rehabilitation or replacement, point repairs, manhole preparation, and testing operations.**
- C. Cleaning shall dislodge, transport and remove all sludge, mud, sand, gravel, rocks, bricks, grease, roots, sticks, and all other debris from the interior of the sewer pipe and manholes.**
- D. The intent of cleaning the sewer line is to completely remove all foreign materials from the sewer to restore it to 100% of the original pipe carrying capacity or as required for the proper installation of a pipe liner or the performance of other rehabilitation work.**
- E. If conditions such as broken, collapsed, or blocked pipe exist which will prevent the cleaning of the pipe, the CONTRACTOR shall consult with the OWNER prior to proceeding further with cleaning operations.**
- F. Related sections:**
  - 1. The WORK of this section applies to the work of the following sections. Other sections of the specifications, not referenced below, shall also apply to the extent required for proper performance of WORK.**
    - a. 33 01 30.61 – Sewer and Pipe Joint Sealing**
    - b. 33 01 30.16 – TV Inspection of Gravity Pipelines**
    - c. 33 01 12 – Sewer Flow Control**
    - d. 33 01 30.71 – Rehabilitation of Sewer Utilities**

#### **1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS**

- A. APWA / AGC Standard Specifications for Public Works Construction, latest edition.**

#### **1.3 CONTRACTOR SUBMITTALS**

- A. Submittals required herein shall be in accordance with Section 01 33 00 – Submittal Procedures.**

### **PART 2 – PRODUCTS**

#### **2.1 EQUIPMENT**

- A. Temporary valves, bulkheads, or other water control equipment and materials shall be as specified herein and/or as determined by the CONTRACTOR subject to the ENGINEER'S review. No materials shall be used which would be injurious to pipeline structure and future function.

### **PART 3 – EXECUTION**

#### **3.1 SERVICES OF THE MANUFACTURER**

##### **A. Performance**

1. The equipment and methods selected shall be based on the conditions of lines and manholes at the time the work commences and shall be satisfactory to the OWNER. The equipment shall be capable of removing dirt, grease, rocks, sand, and other materials and obstructions from the sewer lines and manholes. If cleaning of an entire section cannot be successfully performed from one manhole, the equipment shall be set up on the other manhole and cleaning again attempted. If, again, successful cleaning cannot be performed or the equipment fails to traverse the entire manhole section, the cleaning effort shall be stopped and sufficient inspection performed so that the OWNER can be notified of the reason for inability to continue.
2. Use properly selected equipment to remove all dirt, grease, rock and other deleterious materials and obstructions.
3. Protect existing sewer lines from damage caused by improper use of cleaning equipment.
4. All precautions shall be taken to protect downstream pumping equipment, and any damage to such equipment shall be repaired at the CONTRACTOR's expense.
5. Take precautions to avoid damage or flooding to public or private property being served by the line being cleaned.
6. Where water from the OWNER is not available, the CONTRACTOR shall furnish water by tank truck or barrels.

##### **B. Removal of Materials**

1. Remove all solids and semi-solids at the downstream manhole of the section being cleaned.
2. Passing material from one section of a line to another will not be permitted.

##### **C. Disposal of Materials**

1. Remove from the site and properly dispose of all solids or semi-solids recovered during the cleaning operation including all transportation, drying and disposal fees. The CONTRACTOR shall obtain permits and make arrangements as required to properly dispose of solids. The disposal location shall be approved by the OWNER.

2. No sewer cleaning shall take place in a particular sewer segment until all upstream pipe segments have been cleaned. If cleaning is done in a downstream pipe segment in order to facilitate overall cleaning operations, the segment shall be re-cleaned at no additional cost, after all pipes upstream of that segment have been cleaned.
3. If root intrusion is sufficiently heavy to prevent the completion of inspection, the cleaning effort shall be stopped and the OWNER notified. The OWNER may authorize root removal as a separate pay item in such cases, or following completion of successful cleaning and inspection. Root removal not authorized in writing by the OWNER shall be considered part of the cleaning operation and shall not be considered a separate pay item. Root removal in preparation for liner installation or for test and-seal work shall not be considered a separate pay item. When authorized, special attention should be used to ensure substantially complete removal of roots from the joints. Any roots which could prevent the seating of the packer or could prevent the proper application of chemical sealants shall be removed. The equipment and methods selected shall be based on the conditions of lines at the time the WORK commences and shall be satisfactory to the OWNER.
4. The CONTRACTOR shall be responsible for any physical damage to the CONTRACTOR's own equipment, or to the sewer system, that may result from cleaning operations. Any such damage will be corrected at the CONTRACTOR's expense.

### 3.2 FIELD QUALITY CONTROL

- A. Acceptance of this portion of the WORK shall be dependent upon the results of the television inspection. Lines not acceptably clean as to permit television inspection shall be re-cleaned and re-inspected at no additional cost to the OWNER.

END OF SECTION

## **SECTION 33 01 30.61 – SEWER AND PIPE JOINT SEALING**

### **PART 1 – GENERAL**

#### **1.1 THE REQUIREMENT**

- A. The work in this Section consists of providing for the rehabilitation of defective pipe joints, some circumferential pipe cracks and other small pipe defects by the application of chemical grouting materials and shall be in accordance with ASTM F-2304-03.

#### **1.2 REFERENCE SPECIFICATIONS, CODES AND STANDARDS**

- A. The following standards are referenced in this specification:
1. ASTM F 2304: Standard Practice for Rehabilitation of Sewers Using Chemical Grouting
- B. Where reference is made to the above standards, the revision in effect at the time of the bid opening shall apply.
- C. The following sections are referenced in this specification:
1. Section 01 33 00 – Submittal Procedures
  2. Section 01 66 00 – Product Storage and Handling Requirements
  3. Section 33 01 12 – Sewer Flow Control
  4. Section 33 01 30.13 – Sewer and Manhole Testing
  5. Section 33 01 30.16 – TV inspection of Gravity Pipelines
  6. Section 33 01 30.41 – Cleaning of Sewers

#### **1.3 CONTRACTOR SUBMITTALS**

- A. Furnish Submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Contractor shall submit pump calibration information, field sealing records, certification of pressure sensing/monitoring equipment, current documentation of Contractor's compliance with product manufacturer's Safe Operating Practices Procedures (SOPP) as approved by the U.S. EPA. Further, upon request, the Contractor must submit proof of chemical supplier's product liability insurance.
- C. Before starting work, submit manufacturer's literature describing the components, mixing and handling procedures, and characteristics of the set time for the proposed grout products to the Owner for review before start of injection work. Also submit Contractor's operating procedures.
- D. With the bid documents, submit written documentation of at least two (2) years of experience in completing similar chemical grouting pipeline repair.

- E. The accuracy and calibration of pressure sensing/monitoring system shall have been certified by an independent testing firm within a one-month period preceding the use of equipment. Proof of certification shall be submitted to the Owner.

#### 1.4 WARRANTY

1. The Contractor shall guarantee the sealing of the pipe joint by the grout for one full year from the date of acceptance of the Owner to the extent that he will repair and/or re-grout any defects including, but not limited to, root penetration, signs of infiltration, and cracks in the pipe or grouting material, which may appear in the structure because of faulty design, workmanship, or material furnished by him.
2. Prior to the expiration of the guaranty period, an initial retest area consisting of specific manhole sections shall be selected by the Engineer/Owner. Manhole sections to be retested shall be randomly selected throughout the project area and shall be representative of the majority of the sealing work originally performed. The initial test area shall consist of at least 5%, but not exceed 10%, of the linear feet contained in the original project.
3. Within the initial retest area, the Contractor shall retest all previously sealed joints as specified in Section 33 01 30.13 – Sewer and Manhole Testing. Any joints failing the retest shall be resealed. If the failure rate of the retested joints is less than 5% of the joints retested, the work shall be considered satisfactory and no further retesting will be required. Payment for retesting the initial area shall be at the unit price bid for each item of work required (e.g.: cleaning, TV inspection, testing, etc.). No compensation shall be provided for resealing (grouting) joints that fail.
4. If in the initial retest area, the failure rate of the retested joints exceeds 5% of the joints retested, an additional retest area of equivalent size shall be selected and all previously sealed joints shall be retested. This additional testing and sealing, if necessary, will continue until a failure rate of less than 5% is met. Any additional testing/sealing required beyond the initial retest area shall be accomplished at no cost to the owner.
5. Should as much 25% of the original project be retested and fail to meet the 5% requirement, the Contractor will be required to provide the same number of crews as utilized in the original project so that the retesting will proceed at a more rapid rate.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Storage and handling shall be in accordance with Section 01 66 00 - Product Storage and Handling Requirements.

#### 1.6 TEMPORARY WATER

- A. If available, the Owner will provide all water for construction purposes for use by the Contractor at no expense. Temporary water supply and connections to hydrants shall meet all Owner requirements.

## 1.7 SAFETY

- A. Contractor shall be solely responsible for safety during the performance of all Work. Contractor shall take satisfactory precautions to protect the sewer segments and appurtenances from damage that might be inflicted upon them by the use of grouting equipment. Any damage inflicted upon a sewer segment or other public or private property as a result of the Contractor's grouting operations, regardless of the grouting method used and regardless of any other circumstance which may contribute to the damage, shall be repaired by Contractor at his sole expense.
- B. Contractor shall not enter into any sewer segment where hazardous conditions may exist until such time as the source of those conditions is identified and eliminated by the Contractor. Contractor shall perform all work in accordance with the latest OSHA confined space entry regulations. Contractor shall coordinate his work with local fire, police and emergency rescue units.
- C. The CONTRACTOR shall carry out his/her operations in a safe manner and in accordance with all applicable state and federal requirements and regulations.

## 1.8 MINIMUM QUALIFICATIONS

- A. Materials: Chemical sealant shall have documented service of successful performance in similar usage, with a minimum of 12,000 joints grouted.

## PART 2 -- PRODUCTS

### 2.1 MATERIALS

#### A. Chemical Grout

1. Grout used shall be acrylamide or equal. Contractor shall provide a chemical sealant solution containing principal chemical sealant constituent, initiator (trigger) and catalyst specifically recommended for the purpose of sealing leaks in sanitary sewer lines and manholes. Chemical sealant constituent, initiator (trigger) and catalyst shall be compatible when mixed. Solution shall have ability to tolerate dilution and react in moving water. After final reaction, it shall be a stiff, impermeable, yet flexible gel. Grout shall make true solution at concentrations as high as three pounds per gallon of water. Solutions shall have ability to accept dilution by groundwater of at least 50% by volume, without significantly changing sealing ability of the gel when at rest or in motion. Solutions shall gel in a predetermined time when exposed to normal groundwater pH ranges, and be capable of formula adjustments to compensate for changing conditions. Final reaction shall produce a continuous, irreversible, impermeable stiff gel at chemical concentrations as low as 0.4 pounds per gallon of water that is able to break away from the joint sealing packer when the packer is deflated. Gel shall not be rigid or brittle. Gel shall have negligible corrosion rate on mild steel plates.
2. At the direction of the Owner, reinforcing agents (5612 by 3M or AV-257 by Avanti) will be added to the polyurethane grout, as well as a root inhibitor. These additives will be used in accordance with manufacturer specifications, and at no additional cost to the Owner.

3. Chemical grout manufacturers are those specified in Palm Beach County Water Utilities Department Engineering Services Division – Approved Materials and Equipment List (Latest Version) or Approved equal.

**B. Chemical Root Inhibitor**

1. Dichlobenil (2-6-dichlorobenzonitrile): Norosac - AC50-W or approved equal
  2. Contractor shall add root inhibitor to the chemical grout mixture at a safe level of concentration having the ability to remain active within the grout for a minimum of 12 months.
  3. Contractor shall mix root inhibitor with the grout according to the instructions of the grout manufacturer and in the specified quantities as recommended by the grout manufacturer.
- C. Non-Shrink Mortar:** A mixture of fine sand, cement and water with a water cement ratio not greater than 0.35.
- D. Water shall be potable.**

**2.2 EQUIPMENT**

**A. General:**

1. Supply all equipment including suitably sized packers, pumps, and ancillary equipment as required to perform the work described in this specification. Use equipment of a type, capacity, and mechanical condition suitable for accomplishing the work. Equipment shall be compatible with the chemicals being used and the grout manufacturer's recommendations: The basic equipment shall consist of a closed-circuit television system, necessary chemical sealant containers, pumps, regulators, valves, hoses, etc., and joint sealing packers for the various sizes of sewer pipes. The packer shall be cylindrical and have a diameter less than the pipe size and have cables attached at each end to pull it through the line: The packer device shall be constructed in a manner to allow a restricted amount of sewage to flow and shall be pneumatically operated. Hydraulically or mechanically expanded devices shall not be permitted. Generally, the equipment shall be capable of performing the specified operations in lines where flows do not exceed the maximum line flows for joint testing/sealing.

**B. Pumping Units:**

1. Provide pumping units, including separate chemical containers, hoses, and other accessories for injection of grout. Use pumping units made of materials compatible with the chemicals being used, as recommended by the grout manufacturer. Arrange and operate pumps in a manner consistent with the grouts injected and the grout manufacturer's recommendations.
2. Use pumps capable of continuous injection of liquid grout in accordance with the manufacturer's recommendations. Arrange pumps so that rapid changes in pumping

rates and pressures can be obtained by the pump operator without affecting the mixture of the grout being injected and without stopping the pump.

3. Equip pumps with necessary hoses, chemical containers, gauges, fittings, packers, and other accessories required to inject the grout properly. Use hoses and fittings conforming to maximum safe operating pressure ratings and dimensions, as recommended by the manufacturer. Do not allow the leakage of grout at seals and joints; seal the system to prevent air from being aspirated into the injected grout.
  4. Supply suitable mixing and holding tanks with each grouting unit to permit continuous pumping at maximum pump capacity.
  5. Equip pumping units with accurate pressure gages at the pump and near the injection point. Use gages which are accurate to within 5 percent; periodically check gages for accuracy against calibrated gages. Replace damaged or inaccurate gages. Do not operate pumping units without properly operating gages. Keep replacement gauges on hand.
  6. Use grouting units assembled so that flushing can be accomplished with grout intake valves closed, flushing fluid supply valves open, and the pump operated at full speed.
- C. Packers: Use packers for sealing operations in sewers which are specifically designed for grouting operations, and which are capable of safely sealing and packing at pressures as recommended by the manufacturer of the grout.
- D. Injectors: Use injectors for sealing operations in sewers which are specifically designed for grouting operations, and which are capable of safely sealing and packing grout holes drilled into concrete and brick manhole structures and injecting at pressures as recommended by the manufacturer of the grout. Provide removable type injectors so that drilled hole can be cleaned and patched.
- E. Drills: Provide drills capable of drilling concrete and brick manhole structures, and with bits of a diameter and length consistent with injection requirements and hole lengths needed for the drilled holes to intersect the target crack or joint.
- F. Water Removal Equipment and Supplies: Provide equipment and supplies as necessary to remove water in order to permit visual observation of leaks. Such equipment shall include but not be limited to: wet-dry vacuums, pumps, air blowers, mops, and rags. Temporary dams shall be constructed as needed using sand bags or other suitable materials to keep water out of areas being actively grouted.
- G. Bypassing Flow: As necessary to allow for sewer grouting, supply necessary sand bags, dams, diversion pipes, and pumps for bypassing flow as specified in Section 33 01 12 – Sewer Flow Control.
- H. Testing:
1. To test the accuracy, integrity, and performance capabilities of sealing equipment units, Contractor shall perform a demonstration test in a test cylinder constructed so that a minimum of two known leak sizes can be simulated. Contractor shall provide



test cylinders and pressure gauges. Contractor shall perform the demonstration test for each chemical sealing unit prior to beginning work. This technique will establish test equipment performance capability in relationship to test criteria and insure that there is no leakage of the test medium from the system or other equipment defects that could affect joint testing results. Tests may be required at any other time during joint testing work if the Owner suspects testing equipment is not functioning properly. All testing costs shall be borne by the Contractor.

### **PART 3 – EXECUTION**

#### **3.1 GENERAL**

- A. Provide safe and efficient access to drilling and grouting areas for workers, supervisors, and inspectors. Lighting shall also be provided for inspection and performance of the work.**
- B. Provide temporary power within the work area and plan for installation of outlets, connection boxes, transformers, cables, switches, and generators that may be necessary to supply the work crew with the electrical power.**
- C. Provide access for the Owner at all times to injection locations. The Owner's detailed instructions as to location of defect shall be followed.**
- D. Maintain accurate and complete up-to-date records of the work, including specific daily grout crew reports detailing the locations of cracks and grout holes, types and amounts injected at each hole, observations of grout travel and leakage, pressures used, and any pertinent observations of the grouting process.**
- E. Provide direct oral communication between the worker at the point of injection and the grout pump operator at the surface.**
- F. Plan to perform grouting work in a single pass of the grouting crews through the designated pipe sections.**
- G. The Contractor shall be responsible for any physical damage to the Contractor's own equipment, or to the sewer system, that may result from grouting operations. Any such damage will be corrected at the Contractor's expense.**

#### **3.2 CLEANING**

- A. Prior to the application of chemical grouting materials, Contractor shall thoroughly clean the sewer designated to receive the chemical grouting in accordance with Section 33 01 30.41 - Cleaning of Sewers. Cleaning shall constitute removal of all debris, solids, roots and other deposits in the sewer line; particularly at the sewer pipe joints.**
- B. Acceptance of cleaning work in sewer line sections shall not be made until testing and sealing of joints and cracks in section of the respective sewer have been completed.**

### 3.3 INSPECTION OF PIPELINES

- A. After cleaning and prior to application of chemical grouting materials, Contractor shall inspect the sewer designated to receive the chemical grouting. Sewer line inspection requirements shall be in accordance with Section 33 01 30.16 - TV inspection of Sewer Pipelines.

### 3.4 SEWAGE FLOW CONTROL

- A. Contractor shall provide for maintenance of flow in the affected portions of the sewer system during grouting of the sewer line. Requirements for sewage flow control and bypass pumping shall be in accordance with the requirements of Section 33 01 12 – Sewer Flow Control.
- B. Sewage flow control shall be employed by Contractor when sewer line depth of flow at the upstream manhole of the sewer line section being worked is above the maximum allowable for joint testing and sealing. Flow control shall be accomplished by bypass pumping of flow from upstream of the sewer segment to be grouted to a point downstream of the sewer segment to be grouted.
- C. Depth of flow shall not exceed that shown below for respective pipe sizes as measured in the upstream and downstream manholes when performing joint testing and sealing.

Maximum Depth of Flow for Joint Testing/Sealing	
8 in. – 24 in. diameter pipe	25% of pipe diameter
Pipe larger than 24 in. diameter	30% of pipe diameter

### 3.5 PRESSURE TESTING JOINTS IN SANITARY SEWER

#### A. Preconstruction Testing

1. Contractor shall provide equipment such as pumps, gauges, regulators, and hoses, necessary to perform air tests of each joint in those sewer sections designated for grouting work. Equipment configuration shall be such that there are no valves on or along the air line between the measuring point at the joint and the pressure transducer or sensing device located in the control unit on the surface. Systems which incorporate bladders, hoses, or the like for monitoring the pressures and which have questionable accuracy shall not be allowed. The amount of pressure being exerted on the joint shall be readable above ground on a pressure gauge.
2. To confirm that joint testing is not a more severe test than the pipe itself can pass, Contractor shall perform an on-job barrel test between joints in each pipe line to be tested to determine that the pipe barrel can pass the test criteria. If the pipe barrel will not pass decay rate limits, adjustment of maximum pressure levels will be evaluated jointly between Contractor and Owner. Owner shall render final written decision on each such situation.

#### B. Sewer Pipe Joint Testing

1. To determine if a joint needs grouting, Contractor shall test each joint by isolating the area to be tested within the testing device and applying positive pressure into the joint and void area created by the test device. Contractor shall then introduce pressurized air into the isolated void created by testing device. Pressure shall be applied until it is determined that the pressure cannot be built in the void or until the test pressure of 1/2 psi per foot of depth plus four psi to a maximum of 10 psi is reached as recorded by the void pressure monitor. When either of these conditions is reached, Contractor shall shut off the air supply.
2. If the required pressure cannot be developed, joint shall have failed the test. If the required test pressure in the void was increased to 1/2 psi per foot of depth plus four psi, rate of decay of this pressure shall not exceed 1 psi in 30 sec. The joint being tested will also have failed if the pressure drops more than 1 psi in 30 seconds. Failure of the joint indicates the need for sealing. Sealing shall be accomplished by Contractor as specified in this specification. Sewer pipe joint testing shall be in accordance with Section 33 01 30.13 – Sewer and Manhole Testing.

#### C. Test Records

1. During grout testing, records shall be kept which include identification of the sewer section tested (upstream and downstream manhole numbers), test pressure used, location (footage counters) of each grouted defect tested and location of grouted defects not tested due to close proximity to building service connections and sanitary sewer manholes, a statement indicating test results (passed or failed) for each grouted defect tested, test pressure achieved and maintained for each grouted defect passing air test, weekly equipment pressure test results, sewer section barrel test results, daily gel check results, and air temperature at time of testing joints.

### 3.6 CHEMICAL GROUT APPLICATION FOR SEALING JOINTS

#### A. Placement of Chemical Grout

1. 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.
2. Jetting or driving pipes from the surface that could damage or cause undermining of the pipe lines shall not be allowed unless specifically authorized in writing by the Owner. Uncovering the pipe by excavation of pavement and soil (which could disrupt traffic, undermine adjacent utilities and structures, and cause further damage to the pipe lines being repaired) shall not be allowed unless specifically authorized in writing by the Owner.
3. Repairs shall take place at joints, generally small circumferential cracks, small holes, or similar points of infiltration as identified. The repair shall be such that the original cross-sectional area and shape of the interior of sewer pipe shall not be permanently reduced or changed.
4. Contractor shall position the sealing packer over the area of infiltration by means of a metering device at the surface and closed circuit television camera in the line.

Accurate measurement of the location of the defect to be sealed shall be made, using the portion of sealing packer as "Datum" or measurement point or target. Such measurement to the target shall also be used to obtain necessary measurement for positioning the injection area of sealing packer over area to be sealed.

5. Contractor shall expand the sealing packer sleeves using controlled pressures. Expanded sleeve shall seal against the inside periphery of pipe to form a void area at the point of infiltration, completely isolated from the remainder of the line. Contractor shall pump sealant materials into this isolated area through hose systems at controlled pressures which are in excess of groundwater pressures. Contractor shall pump as much grout as is field-required to seal any leaks and fill the voids. Grout shall break away from the packer and stay in place when the packer is deflated and moved from the point of infiltration.
6. Upon completion of injection and sealing of each individual joint, the packer shall be deflated until the void pressure meter reads zero pressure, and then re-inflated and the joint retested. Contractor shall retest the point of repair. If retesting shows the seal was not completely effective, Contractor shall repeat the sealing process until the defect successfully passes the pressure test. After sealing the entire sewer section, Contractor shall remove surplus grouting material from section at the immediate downstream manhole. If surplus grouting materials left in the sewer section by Contractor results in sewer surcharging and subsequent damage to public or private property, Contractor shall be responsible for damage to property and expenses incurred by Owner.
7. Injection Pressure at Completion: Joint grout injection is completed when the void pressure reaches 8 psi or higher and does not drop more than 1 psi after 30 seconds holding time.
8. The records shall identify, using upstream and downstream manhole numbers and footage counters, the pipe section in which the sealing was done, the location of each joint sealed, and the joint sealing verification results as specified in Section 33 01 30.13 – Sewer and Manhole Testing.

#### B. Gel Checks

1. Contractor shall make gel checks daily for each sealing vehicle to monitor both induction period and gel characteristics. Contractor shall also make checks for every mixed batch or at least twice per day if only one batch is used. Periodic gel checks shall also be made in the pipe (at request of Owner) by seating the sealing packer on the pipe barrel and filling the packer void with grout solutions. Pressure will then be monitored until a rise in pressure is observed, indicating that grout has gelled in the packer void. Contractor shall certify, for each of the sealing vehicles, results of required gel checks.

#### C. Injection Procedures for Cracks:

1. Cleaning the cracks: Clean the cracks to remove any contamination by flushing with water or special solvent. Then blow out the water or solvent with compressed air to permit observation of leak sources and direction of water flow along a given crack. Use this information in planning the location and injection sequence of grout holes.

2. **Drilling the holes:** The holes shall be drilled at an angle sufficient to intersect the crack at approximately half the thickness of the wall for thicker walls. In thin concrete walls of 6 inches or less, the injection holes shall be drilled directly into the crack. The wider the crack, the greater the distance of grout travel, and the farther apart the injection holes
3. **Flush the crack:** The crack shall be flushed with clean water prior to injection of the grout. The flushing action of the water shall wash dirt and dust from the crack. The water in the crack will also assist in curing the grout as the grout material reacts with the water left in the crack.
4. **Remove injectors:** After sufficient curing, injectors can be removed from their drill holes.
5. **Patch injection holes:** Once injectors are removed, the injection holes shall be patched with quick setting hydraulic cement
6. **Removing excess:** Remove excess surface grout from the crack surface area, wipe the crack face clean and apply a band of surface sealer to the crack face.
7. **Sealing of large cracks:** Sealing large cracks can be accomplished the same way as for fine crack sealing. However, the application of a surface "dam" such as activated oakum, lead wool, or quick set hydraulic cement may first be needed to prevent rapid flow of grout from the crack. Injectors can be set directly into the crack.

**D. Field Records**

1. Contractor shall keep field records for each sewer section prior to, during, and after completion of the chemical grouting operation. Records shall include information such as accurate locations, gel times, grout volumes, grout pressures, air temperatures, and joints not sealed due to close proximity to building service connections and sanitary sewer manholes.

**3.7 FIELD QUALITY CONTROL**

- A. Locate weep holes, drains, and utility lines during injection operations and control the work to prevent clogging them with grout.
- B. Mark repaired leaks in manholes by painting the location with high visibility paint that will adhere to pipe site conditions.
- C. The process anticipates the loss of some grout to surface leaks and reappearance of leaks in previously treated areas. Minimize the loss of grout and reduce the incidence of leak recurrence. Retreat reoccurring leaks as directed by the Owner.
- D. The entire joint sealing process shall be recorded and documented as referenced in Section 33 01 30.13 - Sewer and Manhole Testing.

### **3.8 POST INSTALLATION CLEANING**

- A. Remove leaked grout and other debris resulting from the work. Place drilling debris, grout, and contaminated water in proper containers for disposal. Completely clean-up materials used in the process. Provide for adequate disposal of temporary crack packing, washing chemicals, wasted or leaked grout, drill cuttings, and other debris. Dispose of debris on a daily basis. Restore the site to a clean, tidy condition.**
- B. Remove temporary electrical devices at the completion of the work.**
- C. Prior to leaving a work area, wipe off visible grout on pipe surfaces and restore the surface to a clean, tidy condition.**
- D. All cleaning and flushing chemicals shall be handled, collected, and disposed of in accordance with applicable regulations. Such materials shall specifically not be disposed of into the sewer or on the ground.**

**- END OF SECTION -**

## **SECTION 33 01 30.71 – REHABILITATION OF SEWER UTILITIES**

### **PART 1 – GENERAL**

#### **1.1 THE REQUIREMENT**

- A. Furnish all labor, materials, equipment, and Incidentals required to install open cut point repairs to rehabilitate existing sewers with limited defects as shown on the Drawings or as directed by the Construction Manager. These repairs are intended to address specific, local defects such as fractures, separated/open joints, holes, voids, sheared pipe, infiltration sources, etc., identified by closed circuit television (CCTV) inspection generally of a singular structural nature and not requiring rehabilitation for the entire manhole-to-manhole length.**
- B. Furnish all labor, materials, equipment, and incidentals required to conduct post-rehabilitation CCTV inspections and other requirements described herein for final point repair acceptance.**

#### **1.2 SUMMARY**

- A. Methods, procedures and requirements are similar when sections of existing pipe have been crushed, cracked, or settled, or have holes in them and are to be replaced with new pipe. Generally, point repairs are made at specific locations and involve relatively short lengths of sewer or fittings (up to 15 feet) which are to be repaired or replaced. "Isolation" of affected reaches of sewer by plugging and/or bypass pumping, if required, shall be performed as specified in Section 33 01 12 – Sewer Flow Control.**
- B. Locations where point repairs are to be made will be made available to the CONTRACTOR through Work Orders and will be based on previously performed smoke tests and television surveys. It is understood that the exact location of pipe leaks and failures cannot always be determined before the pipe is exposed because the smoke injected into the existing pipe to detect their presence can migrate through passages in the earth, and overburden, and may not emerge directly over the leak or failure.**
- C. It is also understood that the smoke testing and closed circuit television surveys performed by others prior to the commencement of this project cannot always determine the precise cause of leakage or failure. The pipe shall be exposed and the source located, examined and evaluated before repairs are made. Additional smoke shall be introduced into the pipe by the CONTRACTOR to aid in the final evaluation and determination of required work if necessary to locate the area to be repaired.**
- D. After each designated External Unpaved Point Repair has been made, the Contractor will perform a CCTV inspection in accordance with Section 33 01 30.16 – TV Inspection of Sewer Pipelines. The CCTV video and inspection report will be submitted to the County for review. The cost of the CCTV inspection shall be included in the unit price for Unpaved External Point Repair. If a repaired joint or section should prove to be defective, the Contractor shall re-perform the work at no additional cost to the County and shall also be responsible for the costs of any re-inspection required by the County to document the success of the re-work. Where work is to be performed on private property, the CONTRACTOR shall consult with the OWNER who will make arrangements and schedules with the property owners before the CONTRACTOR performs the work.**

- E. Excavation, backfill, exploratory excavation, sheeting and shoring, dewatering, conflicts with other utilities, and miscellaneous work shall conform to the requirements of Section 31 23 33 – Trenching and Backfill.

### 1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

1. Palm Beach County Water Utilities Department Engineering Services Division - Approved Materials and Equipment List (Latest Version)
2. Section 01 33 00 – Submittal Procedures
3. Section 01 66 00 – Product Storage and Handling Requirements
4. Section 31 23 33 – Trenching and Backfilling
5. Section 33 01 12 – Sewer Flow Control
6. Section 33 01 30.16 – TV Inspection of Gravity Pipelines
7. Section 33 11 00 – Sanitary Sewer Flexible Couplings

### 1.4 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures.

### 1.5 QUALIFICATIONS

- A. The Qualifications of the CONTRACTOR shall be submitted prior to contract award. These Qualifications shall include detailed descriptions of the following:
  1. Name, business address and telephone number of the CONTRACTOR.
  2. Name(s) of all supervisory personnel to be directly involved with this project.
  3. The CONTRACTOR shall sign and date the information provided and certify that to the extent of his knowledge, the information is true and accurate, and that the supervisory personnel will be directly involved with and used on this project. Substitutions of personnel and/or methods will not be allowed without written authorization of the OWNER.
  4. The CONTRACTOR shall provide his references of previous project lists going back five years including his customers' names, addresses, and telephone numbers.
  5. To be qualified, the CONTRACTOR shall have a minimum of five years previous experience in the work required in this section.

### 1.6 TELEVISION SURVEY

- A. Television survey, including Preconstruction Survey and Post Construction Survey as indicated in Section 33 01 30.16 – TV Inspection of Gravity Pipelines, is required for all point repairs of sanitary sewers.



**1.7 DELIVERY, HANDLING AND STORAGE**

- A. Storage and handling shall be in accordance with Section 01 66 00 - Product Storage and Handling Requirements.

**1.8 PUBLIC NOTIFICATION**

- A. Three (3) days prior to beginning the Work, provide written notification to the owners and residents of any homes or businesses whose service will be affected by the Work. Include in the notifications the description of the work being done and any restrictions about using the sewage system facilities specifying the exact days and hours the sewer system may not be used.
- B. Provide copies of the delivered notices to the Construction Manager.
- C. THE MAXIMUM TIME ANY HOME OR BUSINESS SHALL BE WITHOUT SANITARY SEWER SERVICE IS 10 HOURS BETWEEN 8:00 A.M. AND 6:00 P.M. ANY SERVICE OUT LONGER THAN 10 HOURS SHALL HAVE MEASURES TAKEN TO PROVIDE TEMPORARY SERVICE AT CONTRACTOR'S EXPENSE. SERVICE DISRUPTIONS BETWEEN THE HOURS OF 8:00 P.M. AND 6:00 A.M. ARE NOT PERMITTED AND SHALL BE RESTORED IMMEDIATELY AT THE CONTRACTOR'S EXPENSE.

**1.9 WARRANTY**

- A. All point repair work shall be fully guaranteed by the Contractor and manufacturer for 3 years from the acceptance date. A written warranty shall be submitted. During this period, all serious defects including seal failure between the point repair and the main sewer shall be removed and replaced by the Contractor in a satisfactory manner at no additional cost to County. At its own expense, County may conduct an independent television inspection of the point repair work prior to the guarantee period's completion. Any defects repaired at that time shall be fully guaranteed by the Contractor and manufacturer for 1 year from the date the defect was repaired. Wrinkles, blisters, dry spots in resin, unexpanded tabs or other defects in the finished point repair, which in the Construction Manager's opinion negatively affect the pipe's integrity, strength, flow capacity, or solids passage performance are unacceptable. The Contractor will be responsible for removing and repairing, at the Contractor's expense, all such defects in a manner satisfactory to the Construction Manager. Defects also include but are not limited to the following:
1. Leakage through the point repair or between point repair and pipe
  2. Point repair separating from the pipe
  3. Collapsed mechanical type sleeves or liners
  4. Non-expanded sleeves or liners with poor end transitions
  5. Excessive wrinkles or other obstructions inhibiting flow through the sewer

## **PART 2 -- PRODUCTS**

### **2.1 GENERAL**

- A. Pipe materials are specified in the Palm Beach County Water Utilities Department Engineering Services Division - Approved Materials and Equipment List (Latest Version).
- B. Pipe-to-pipe connections shall be made in accordance with 40 05 00 – Piping, General, by using flexible banded couplings or adapters, couplings with compression joints in compliance with ASTM C 425.
- C. When a sound pipe stub-out exists from a manhole to which connection is to be made, a pipe-to-pipe connection shall be made as described above. If one is not present or is faulty, an opening shall be cut in the manhole wall and the connection, consisting of a pipe stub-out with an EPDM rubber boot assembly grouted into the opening with non-shrink grout shall be made to form a corrosion resistant, watertight seal. The invert, benches and floor inside the manhole shall be cut and reshaped as necessary.

## **PART 3 -- EXECUTION**

### **3.1 PRE-INSTALLATION**

- A. A digital CCTV video inspection must be performed by the CONTRACTOR on sections of the mainline pipe to be rehabilitated using a pan and tilt camera to confirm the proposed repair falls within the limitation parameters set by the manufacturer, including, but not limited to, the following:
  - 1. Any offsets or intrusions into the main
  - 2. Potential flows going through the main pipe
  - 3. Main pipe's size at the point repair location
  - 4. Condition including the presence of debris, changes in diameter, or other observations
  - 5. Active infiltration present within the work area vicinity
  - 6. Any defects noted in the mainline pipe should be documented using NASSCO PACP/LACP Standards.

### **3.2 PREPARATION**

- A. Site preparation shall be performed as described in Division 31. When the repairs are to be made on sewers or facilities lying under paved surfaces, those surfaces shall be removed to the limits specified for point repairs of the particular size pipe involved (trench width plus two feet for concrete surfaces) unless otherwise acceptable to the OWNER.
- B. The CONTRACTOR shall excavate and backfill in accordance with Section 31 23 33 – Trenching and Backfill. Under no circumstances shall the CONTRACTOR be allowed to remove concrete or asphalt without prior saw cutting. The saw cutting shall be deep enough to produce an even, straight cut.

- C. Dewater, sheet and or brace all excavations in accordance with Section 31 23 33 – Trenching and Backfill. Well points, pumps, sheeting, bracing and/or sock drain shall be used to provide a safe, dry, open hole for all repairs or replacements specified herein.
- D. Excavate down to the pipe, completely exposing the pipe up to the next undamaged section of pipe on each side.
- E. Locate the leak to be repaired.

### 3.3 FLOW CONTROL

- A. The Contractor shall be responsible for controlling sewer flows in accordance with Section 33 01 12 – Sewer Flow Control while installing the point repair product. The Contractor shall be solely responsible for cleanup, repair, property damage costs, and claims resulting from its operations.

### 3.4 INSTALLATION - POINT REPAIR OF SANITARY SEWER

- A. After the leak or failure is located and exposed, the CONTRACTOR shall complete the spot repair as follows:
  - 1. Remove and replace section(s) of pipe or fitting. Remove section(s) of defective pipe or fitting by cutting on each side along lines perpendicular to longitudinal axis of pipe so as to leave "spigot ends" to be connected to replacement pipe. Cut or fabricate replacement section. Make connections using stainless steel shear rings from manufacturers as specified in Palm Beach County Water Utilities Department Engineering Services Division - Approved Materials and Equipment List (Latest Version). Bedding or embedment shall be placed and compacted. Reconnect to service line if required. As a minimum, a total of six (6) feet of piping shall be replaced by the CONTRACTOR.

### 3.5 INSTALLATION - POINT REPAIR OF SERVICE LATERAL

- A. In the case of point repairs performed on service laterals, the CONTRACTOR shall:
  - 1. Determine the exact location of the repair by means of television inspection with an electronic locating device (sonde).
- B. Cement-stabilized sand shall be used to supplement the embedment or backfill when accepted by the OWNER. This shall consist of two sacks of cement per cubic yard of sand thoroughly mixed. Only a sufficient amount of water shall be added to assure setting-up of the cement. These mixes shall be made before placing in the trench and only enough shall be prepared to allow placing, shaping and tamping before an initial set has taken place. Cement-stabilized sand shall be used for repairs in FDOT paved right of ways.

### 3.6 POST INSTALLATION

- A. Following the point repair installation, the Contractor shall televise the rehabilitated main beginning 10 feet upstream from the start of the point repair location and extending to the downstream manhole. CCTV inspection shall be completed according to NASSCO

PACP guidelines. When complete, the Contractor shall submit the CCTV inspection data in a Granite NET-compatible database on DVDs or an external USB hard drive.

### 3.7 FIELD TESTING AND ACCEPTANCE

A. The adequacy of point repairs in sewer mains shall be demonstrated by the CONTRACTOR by testing. For service lines, visual review and acceptance by the OWNER will be deemed sufficient. Testing of mains may be accomplished by one of two alternate methods, depending on the depth of the line and the difference in elevation of the pipe at the ends of the reach. Smoke testing shall be used if the pipe slope exceeds one percent. Testing shall be performed while dewatering is continued and before backfilling.

1. Smoke-Testing. The reach of sewer in which the repair (or repairs) has been made shall be isolated by plugging the upstream and downstream manholes as necessary not only to temporarily eliminate the flow of sewage through it but also to prohibit the smoke from entering other reaches of sewer. Smoke shall then be introduced into one of the manholes and into the reach using smoke bombs and a blower especially designed or adapted for smoke testing sanitary sewers and acceptable to the OWNER. The repaired area shall then be observed for the emergence of smoke for a period of 15 minutes. If none can be seen, the repair will be deemed to have passed the test.

2. Exfiltration-Testing: This method may be used only on sewers laid on grades less than 1.00 percent. Water, colored with a bright-colored dye acceptable for usage in testing, is introduced into the pipe so as to impose a 2-foot static head over the top of the pipe at the point of repair when the pipe in the lower manhole is plugged. Observations shall then be made by the OWNER to determine if leakage of the colored water occurs at the repair point. Care shall be taken, when this method is used, that:

- i. Not more than 4-feet of static head are induced on the main at the lower end of the reach, and
- ii. No back-up problems are caused in service lines.

### 3.8 CLEANUP

A. Complete placement and compaction of backfill.

B. Restore surface features to at least as good condition as existed before construction began, including roadways, driveways and walks.

- END OF SECTION -

## SECTION 33 05 13 – MANHOLES AND STRUCTURES

### PART 1 -- GENERAL

#### 1.1 THE SUMMARY

- A. Furnish and install all Precast manholes complete with cast iron manhole frame and cover, pipe connections, Precast concrete base, and any other appurtenances, as shown and specified herein, all in accordance with the requirements of the Contract Documents.
- B. Related sections:
  - 1. Section 01 33 00 – Submittal Procedures
  - 2. Section 31 23 00 – Excavation and Fill
  - 3. Section 03 30 00 – Cast-In-Place Concrete

#### 1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. ASTM A 48 Gray Iron Castings
- B. ASTM C 32 Sewer and Manhole Brick (made from Clay or Shale)
- C. ASTM C 139 Concrete Masonry Units for Construction of Catch Basins and Manholes.
- D. ASTM C 150 Portland Cement
- E. ASTM C 443 Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
- F. ASTM C 478 Precast Reinforced Concrete Manhole Sections
- G. ASTM C 596 Test Method for Drying Shrinkage of Mortar Containing Portland Cement
- H. ASTM C 890 Standard Practice for Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures
- I. ASTM C 913 Standard Specification for Precast Concrete Water and Wastewater Structures
- J. ASTM C 923 Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals

#### 1.3 CONTRACTOR SUBMITTALS

- A. Product Data:
- B. Shop Drawings: Furnish complete shop drawings for all precast manhole sections, cast iron manhole frames and covers, and appurtenances for review, prior to fabrication, by the ENGINEER in accordance with Section 01 33 00 – Submittal Procedures.

1. Show dimensions, locations, lifting inserts, reinforcement, and joints.
2. Structural design calculations for vaults, signed by a registered engineer.
3. Manufacturer's Certification for Vaults: Written certification that the vault complies with the requirements of this Section.

#### 1.4 QUALITY ASSURANCE

- A. Inspection: After installation, demonstrate that all manholes have been properly installed, level, with tight joints, at the correct elevations and orientations, and that the backfilling has been carried out in accordance with the Contract Documents.

### PART 2 -- PRODUCTS

#### 2.1 MATERIALS

- A. Clay Brick: Clay brick shall comply with ASTM C 32, grade SS, hard brick, except that the mean of 5 tests for absorption shall not exceed 8 percent by weight. Submit at least 5 brick of the type proposed for use in this work for review by the ENGINEER.
- B. Concrete Brick: Concrete brick shall conform to ASTM C 139.
- C. Concrete: Concrete for manholes and miscellaneous structures shall conform to the requirements of Section 03 30 00 – Cast-in-Place Concrete. Concrete for field use may be ready-mixed material conforming to the same requirements.
- D. Reinforced Steel: Deformed reinforcing bars shall be grade 60 steel with a minimum yield strength of 60,000 psi, as per ASTM A 615.
- E. Welded wire fabric reinforcement shall conform to the requirements of ASTM A 185.
- F. Cement Mortar: Cement mortar shall consist of a mixture of Portland cement, sand and water. Cement and sand shall first be combined in the proper proportions, and then thoroughly mixed with the required amount of water. Cement mortar shall be proportioned by loose volume in the proportion of one part cement to two parts sand. The quantity of water to be used in the preparation of mortar shall be only that required to produce a mixture sufficiently workable for the purpose intended. Mortar shall be used as soon as possible after mixing and shall show no visible signs of setting prior to use. Retempering of mortar will not be permitted. Cement, sand, and water for cement mortar shall conform to the requirements of Section 03 30 00 – Cast-in-Place Concrete. Lime-cement mortar or commercial mortar mixes are not permitted.
- G. Quick Setting Grout: Quick setting grout shall be a high strength, non-staining grout reviewed by the ENGINEER prior to use. It shall reach the initial set within 90 minutes at 70 degrees F and shall reach minimum compressive strength of 2,500 psi within 24 hours. Shrinkage shall be less than 0.1 percent when tested, using the test procedures of ASTM C 596. The grout shall be mixed, handled, and placed in accordance with the manufacturer's written instructions.

#### 2.2 MANUFACTURED UNITS

**A. Precast Concrete Manholes (Sanitary Sewer)**

1. The CONTRACTOR shall provide precast manhole sections and conical sections conforming to ASTM C 478 and the requirements of this Section. The manhole base and initial conical section shall be cast monolithically. Adjusting rings shall be no more than 4-inches thick and shall be standard items from the manufacturer of the manhole sections.
2. Axial length of sections shall be selected to provide the correct total height with the fewest joints.
3. Conical sections shall be designed to support cast iron frames and covers under an H-20 loading, unless indicated otherwise.
4. Where the manhole barrel diameter is greater than 48-inches, a flat slab-transition, either concentric or eccentric, shall be used to transition to 48-inch diameter riser sections. Underside of the transition shall be at least 7-feet above the top of the bench.
5. Design Criteria: Manhole walls, transitions, conical sections, and base shall be designed per ASTM C 478 for the depths indicated and the following:
  - a. AASHTO H-20 loading applied to the cover.
  - b. Unit weight of soil of 120 pcf located above all portions of the manhole.
  - c. Lateral soil pressure based on saturated soil producing 100 pcf acting on an empty manhole.
  - d. Internal fluid pressure based on unit weight of 63 pcf with manhole filled from invert to cover with no balancing external soil pressure.
  - e. Dead load of manhole sections fully supported by the base and transition.
  - f. Additional reinforcing steel in walls to transfer stresses at openings.
  - g. The minimum clear distance between the edges of any 2 wall penetrations shall be 12-inches or one-half of the diameter of the smaller penetration, whichever is greater.
6. External manhole joint seals shall be applied between all manholes precast section. External manhole joint seals shall be **Cretex Wrap by Marmac Inc., WrapidSeal by Canusa**, or approved equal.
7. Concrete for base and channel formation shall be 4000 psi concrete conforming to Section 03 30 00 - Cast-In-Place Concrete.
8. Barrel section to sewer pipe connections shall be sealed with resilient connectors complying with ASTM C 923. Mechanical devices shall be stainless steel.

**B. Vaults**

1. The CONTRACTOR shall provide precast vaults designed for the indicated applications and of the sizes indicated.
2. The minimum structural member thickness for vaults shall be 5-inches. Cement shall be Type V portland cement as specified in ASTM C 150. The minimum 28-day concrete compressive strength shall be 4,000 psi. All reinforcing steel shall be embedded in the concrete with a minimum clear cover as recommended by ACI 318.
3. Design Loading: Vaults in areas subject to vehicular traffic shall be designed for H-20 traffic loading. Vaults in other areas shall be designed for a vertical live load of 300 psf. Lateral loads on vaults in all areas shall be calculated from:

$$L = 90 h, \text{ plus surcharge of } 240 \text{ psf in areas of vehicular traffic}$$

Where  $L$  = loading in psf

$h$  = depth of fill in feet

4. Where joints are designed in pre-cast concrete vaults, such joints shall be interlocking to secure proper alignment between members and prevent migration of soil through the joint. Structural sections at joints shall be sized sufficiently to reinforce the section against localized distress during transportation and handling and against excess contact bearing pressures through the joint.
5. Where openings for access to the vault are required, the full clear space opening indicated shall be provided, without obstructions from brackets or supports. For large openings where brackets or supports are designed to protrude into the opening for support of required covers, such brackets or supports shall be designed to be easily removed and replaced with a minimum of effort and without cutting or welding.
6. Covers for access openings shall be provided. Frames for covers shall be fabricated from steel, galvanized after fabrication, and shall be integrally cast into the vault concrete sections. All covers shall be tight fitting to prevent the entrance of dirt and debris. Where edge seams are permitted, no gaps greater than 1/16-inch between edges will be accepted. All covers, except round, heavy-weight, cast iron manhole covers, shall have securing mechanisms to hold the covers firmly in place against the effects of repetitious live loads such as pedestrian or vehicle traffic.
7. Where penetration of the pre-cast concrete vault are required for piping, conduit, or ducts, such penetrations shall be accommodated through pre-cast openings or thin-wall knock-out sections. All openings for penetrations shall be smooth and free of surface irregularities and without exposed steel reinforcing. Vaults need not be designed to resist thrust from piping passing through the vault.

#### C. Cast Iron Frames and Covers

1. Castings: Castings for manhole frames and covers shall be non-rocking and shall conform to the requirements of ASTM A 48, Class 30. Unless otherwise indicated, cast iron covers and frames shall be heavy traffic type, 24 inches in diameter, with embossed lettering saying "Sanitary Sewer" to meet the requirements of the Owner



or the local utility company. Frame and cover shall be designed for H-20 traffic loading.

### **PART 3 -- EXECUTION**

#### **3.1 GENERAL**

- A. Pre-cast concrete sections shall be transported and handled with care in accordance with the manufacturer's written recommendations. Where lifting devices are provided in pre-cast sections, such lifting devices shall be used as intended. Where no lifting devices are provided, the CONTRACTOR shall follow the manufacturer's recommendations for lifting procedures to provide proper support during lifting.**
- B. Buried pre-cast concrete vaults shall be assembled and placed in excavations on properly compacted soil foundations as indicated. Pre-cast concrete vaults shall be set to grade and oriented to provide the required dimensions and clearances from pipes and other structures.**
- C. Prior to backfilling, all cracks and voids in pre-cast concrete vaults shall be filled with non-shrink grout or polyurethane sealant, or both. Around pipe and conduit penetrations, openings shall be sealed with polyurethane sealant. With the authorization of the ENGINEER, grout or a closed-cell flexible insulation may be used as filler material prior to placing a final bed of polyurethane sealant.**

#### **3.2 INSTALLATION**

- A. Structures shall be placed along the pipe runs as the sewer pipe is laid. All joints in structures shall be made watertight using approved joint material. All joints shall be worked clean with a wet brush immediately before the jointing of sections. After laying, all remaining space on the inside and outside of the joint shall be filled with mortar and pointed up, with all excess mortar being removed.**
- B. Brick above the roof slab or manhole cone shall be used to bring the manhole to finished grade. Brick shall be thoroughly wetted before laying and shall be laid in a full bed and joint of mortar.**
- C. Work of constructing manholes must be carried on in a manner to insure watertight work. Any leaks in manholes shall be repaired or the entire work shall be removed and rebuilt.**
- D. Manholes shall be completed, including inverts and frames and covers, as the WORK progresses.**

#### **3.3 FIELD ASSEMBLY**

- A. Inverts (Sanitary Sewer Manholes)**
  - 1. Invert channels shall be constructed smooth and semi-circular in shape conforming to the inside of adjacent sewer sections. Changes in direction of flow shall be made in a smooth curve of as large a radius as possible. Changes in size and grade of channels shall be made gradually and evenly. Invert channels shall be formed by one of the following methods:**

- a. Form directly into manhole base
  - b. Build up with brick and mortar
  - c. Lay half sewer pipe in concrete
  - d. Lay full section of sewer pipe through manhole and break out top half
2. The manhole floor outside of invert channels shall be made smooth and sloped toward invert channels.
- B. Drop Connections (Sanitary Sewer Manholes)**
1. Where required, interior drop channels and connections shall be constructed in accordance with the standard details shown on the Drawings.
- C. Foundations (Standard)**
1. The standard foundation for precast manholes shall be 6" of Type "E" crushed limerock as specified in Section 31 23 00 – Excavation and Fill. The foundation shall be well graded and level for the entire width of the manhole base. If over-excavation or under-cutting does occur, the Contractor shall provide a rock foundation, acceptable to the ENGINEER, at no additional cost to the OWNER.
- D. Backfill**
1. Backfill around the structure and over the connection pipes shall be delayed at least 16 hours unless the material around the pipes and structure is hand-placed and tamped up to above the top of the connection pipes. Care shall be used to make sure that all spaces are filled and tamped up to the spring line of the pipe so that there will be no settlement.
  2. Remaining backfill shall be as specified in Section 31 23 00 – Excavation and Fill.

END OF SECTION

## **SECTION 33 95 50 - PVC PRESSURE PIPING, RUBBER JOINTS**

### **PART 1 – GENERAL**

#### **1.1 THE SUMMARY**

- A. Provide polyvinyl chloride (PVC) pressure pipe, complete in place, as indicated in accordance with the Contract Documents.

#### **1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS**

- A. Section 01 11 00 – Summary of Work.
- B. Section 01 74 30 – Pressure Pipeline Testing and Disinfection.
- C. Section 01 77 00 – Closeout Procedures.
- D. Section 02 00 00 – Existing Conditions.
- E. Section 31 23 33 – Trenching and Backfilling.

#### **F. Commercial Standards**

**AWWA C104/A21.5 Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water**

**AWWA C110/A21.10 Ductile-Iron and Gray-Iron Fittings 3-in Through 48-in for Water and Other Liquids**

**AWWA C111/A21.11 Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings**

**AWWA C600 Installation of Ductile-Iron Water Mains and Appurtenances**

**AWWA C900 Polyvinyl Chloride (PVC) Pressure Pipe 4-in Through 12-in for Water Distribution**

**ASTM D 2584 Test Method for Ignition Loss of Cured Reinforced Resins**

**PPI Technical Report TR 3/4 Policies and Procedures for Developing Recommended Hydrostatic Design Stresses for Thermoplastic Pipe Materials**

**AWWA Manual M23 PVC Pipe - Design and Installation**

#### **1.3 CONTRACTOR SUBMITTALS**

- A. Furnish submittals in accordance with the requirements of Section 01 33 00 – Submittal Procedures.
- B. Shop Drawings
  1. Submit drawings of pipe, fittings, and appurtenances.
  2. Submit design calculations in order to demonstrate compliance of pipe and fittings with the requirements of this Section.
  3. Furnish manufacturer's literature for metallic locating tape.

**C. Certifications**

1. Furnish a certified affidavit of compliance for pipe and other products or materials under this Section and the following supplemental requirements:
  - a. hydrostatic proof test reports;
  - b. sustained pressure test reports; and,
  - c. burst strength test reports.
- D. Perform and pay for sampling and testing as necessary for the certifications.
- E. Shop drawing submittals for materials listed as approved in the Water Utilities Department Manual of Minimum Engineering and Construction Standards are not required if the Contractor submits a signed shop specification form attached hereto

**1.4 QUALITY ASSURANCE**

**A. Inspection**

1. Pipe shall be subject to inspection at the place of manufacture.
2. Notify the ENGINEER in writing of the manufacturing starting date, not less than 14 Days prior to the start of any phase of the pipe manufacture.
3. During the manufacture of the pipe, give the ENGINEER access to areas where manufacturing is in process, and permit the ENGINEER to make inspections as necessary to confirm compliance with the indicated requirements.

**B. Testing**

1. Test the materials used in the manufacture of the pipe in accordance with the requirements of this Section and the referenced standards, as applicable.
2. The ENGINEER shall have the right to witness testing, provided that the CONTRACTOR'S schedule is not delayed for the convenience of the ENGINEER.
3. Additional Samples
  - a. In addition to those tests specifically required, the ENGINEER may request additional samples of any material for testing by the OWNER.
  - b. Furnish the additional samples as a part of the WORK.

**PART 2 -- PRODUCTS**

**2.1 GENERAL**

- A. Provide PVC pressure pipe (4-inch through 12-inch) conforming to the applicable requirements of AWWA C900, and the requirements indicated in this Section.

**2.2 PIPE DESIGN CRITERIA**

**A. General**

1. All domestic wastewater force main 12-inch diameter and smaller shall be constructed of polyvinylchloride (PVC) C900 SDR 18 conforming to the requirements of this section.
2. Design PVC pressure pipe wall thickness for internal pressure in accordance with the requirements of AWWA M23, as applicable, and the requirements indicated in this Section.

**B. Determination of External Loads**

1. Compute the dead (earth) loads using the following 2 equations for trench or embankment conditions, as applicable:

a. Trench Condition:

$$W_d = HwB_c$$

Where:	$W_d$	=	earth load in pounds per linear foot
	$H$	=	height of soil cover, feet
	$w$	=	130 lb/cu ft
	$B_c$	=	outside diameter of pipe, feet

b. Positive Projecting Embankment Condition:

$$W_e = C_c w B_c^2$$

Where:	$W_e$	=	Earth load in pounds per linear foot
	$C_c$	=	Calculation coefficient (based on $r_{sd}P$ of 0.75)
	$K_u$	=	0.19
	$w$	=	130 lb/ft <sup>3</sup>
	$B_c$	=	Outside diameter of pipe, feet

**C. Truck Live Loads**

1. Determine the truck live loads using the method recommended by AASHTO in "Standard Specifications for Highway Bridges."
2. For depths of cover less than 10 feet, add HS-20 live loads to the earth loads in order to determine the total load.
3. For depths of cover 3 feet or less, include HS-20 live load plus impact.

**D. Deflection Control**

1. The deflection of the pipe after installation, as determined from the Modified Iowa Formula outlined in AWWA M23, shall not exceed 0.03 times the outside diameter.
2. If the calculated deflection exceeds 0.03 times the outside diameter, increase the pipe class or improve the quality of the pipe zone backfill in order to achieve a higher modulus of soil reaction,  $E'$ .
3. For purposes of calculation, values of  $E'$  shall be 1100 psi at 90 percent Standard Proctor; 1500 psi at 95 percent Standard Proctor; and 2500 psi at 100 percent Standard Proctor, and the deflection lag factor shall be 1.5.

**2.3 PIPE**

- A. Provide pipe of the indicated diameter and pressure class, complete with rubber gaskets.
- B. Provide specials and fittings as indicated.
- C. The dimensions and pressure classes for Dimension Ratios for large PVC pressure pipe with Cast-Iron Pipe Equivalent O.D.s shall conform to the requirements of AWWA C900.
- D. Additives and Fillers
  - 1. Unless otherwise allowed in alternate qualification procedures of PPI-TR3, compounds which have a Hydrostatic Design Basis (HDB) of 4000 psi at 73.4 degrees F and for water shall not contain additives and fillers that exceed the recommended values in Table 1, Part Y of PPI-TR3 (e.g., allowable content range for calcium carbonate is 0.0-5.0 parts per hundred of resin).
  - 2. If requested by the ENGINEER, determine the additive and filler content using the pyrolysis method as specified in ASTM D 2584.
- E. Joints
  - 1. Joints for the buried PVC pipe shall be either an integral bell manufactured on the pipe or a separate coupling both employing a rubber ring joint.
  - 2. Provide the bell and coupling of the same thickness as of the pipe barrel, or greater thickness.
  - 3. Provide the sealing ring groove in the coupling of the same design as the groove in cast iron fittings and valves available from local water works supply distributors.
  - 4. Where indicated, provide ductile iron restrained joint pipe.
  - 5. No restrained joint PVC pipe will be accepted.
- F. Joint Deflection
  - 1. Deflection at the joint shall not exceed 1.5 degrees or the maximum deflection recommended by the manufacturer.
  - 2. No deflection of the joint will be accepted for joints that are over-belled or not belled to the stop mark.

**2.4 PIPE DESIGN SCHEDULE**

Pipe Designation or Pipe Class	Nominal Diameter, inches	Maximum Sustained Pressure, P <sub>w</sub> , psi	Cover Range, feet	Trench Condition Outside Diam+feet	Minimum Compaction, percent
100-5	4	100	5	OD+2	90
200-10	12	200	5-10	Embank	90

## 2.5 FITTINGS

- A. Provide ductile iron fittings conforming to the requirements of AWWA C110, Class 250.
- B. PVC pipe fittings shall be mechanical joint.
- C. Line and coat fittings in accordance with the requirements of Section 09 96 00 – Protective Coatings.
- D. Clearly label each fitting in order to identify its size and pressure class.

## 2.6 Adapters

- A. Where it is necessary to joint pipe of different types, the necessary adapters shall be utilized. Adapters shall have ends conforming to the above specifications for the appropriate type of joint to receive the adjoining pipe.
- B. Adapters joining two classes of pipe may be of the lighter class provided that the annular space in bell and spigot type joints will be sufficient for proper jointing.
- C. The joining of PVC to ductile iron pipe shall be accomplished with flexible compression couplings. Such couplings shall meet the requirements of ASTM C 425.
- D. Refer to the attached "Shop Specifications" for a listing of adapters approved for use on this project.

## 2.7 Tapping Sleeves and Tapping Valves

- A. Provide ductile iron, mechanical joint tapping sleeves. Factory epoxy coated steel tapping sleeves are permissible on existing SDR-26 and SDR-21 PVC pipe only.
- B. Provide as a tapping valve a mechanical joint, iron body, resilient seat gate valve, conforming to those described in these Specifications.
- C. Pressure test the tapping sleeve and valve at 150 psi for one hour. The OWNER and the ENGINEER must be given no less than 48 hours advance notice of the test and must be present to witness the test. The pipe coupon will be carefully preserved and turned over to the OWNER.
- D. Provide double strap tapping saddles with AWWA threads and ball valve curb stop with operating nut gate valve for 1.5-inch and 2-inch taps. Provide double strap tapping saddle with AWWA threads and corporation stop with AWWA inlet threads for taps 1-inch and smaller.
- E. All taps must be not less than 24-inches from a fitting or bell. The tapping line must be smaller than the tapped line, except as approved by the OWNER and the ENGINEER.
- F. A ductile iron tapping sleeve is required for all taps unless the tapping line is less than 1/2 the diameter of the line to be tapped. A steel tapping sleeve is permissible in those cases. Cut-in tee construction may be required by the OWNER depending on the circumstances and sizes involved.
- G. Refer to the attached "Shop Specifications" for a listing of tapping sleeves and tapping valves approved for use on this project.

## **PART 3 -- EXECUTION**

### **3.1 GENERAL**

- A. Perform laying, jointing, and testing for defects and leakage in the presence of the ENGINEER, and obtain the ENGINEER's approval before acceptance.**
- B. Material found to have defects will be rejected, and the CONTRACTOR shall promptly remove such defective materials from the Site.**
- C. Installation shall conform to the requirements of AWWA M23, instructions furnished by the pipe manufacturer, and to the supplementary requirements indicated herein.**
- D. Wherever the provisions of this Section and the aforementioned requirements are in conflict, the more stringent provision shall apply.**

### **3.2 HANDLING AND STORAGE**

#### **A. Handling**

- 1. Carefully inspect pipe, fittings, and accessories before and after installation, and reject those found to be defective.**
- 2. Pipe and fittings shall be free from fins and burrs.**
- 3. Before being placed in position, clean the pipe, fittings, and accessories and maintain them in a clean condition.**
- 4. Provide proper facilities for lowering sections of pipe into trenches.**
- 5. Under no circumstances drop or dump pipe, fittings, or any other material into trenches.**

#### **B. Storage**

- 1. Store pipe, if possible, at the Site in unit packages provided by the manufacturer.**
- 2. Exercise caution to avoid compression damage or deformation to bell ends of the pipe.**
- 3. Store pipe in such a way as to prevent sagging or bending, and protect pipe from exposure to direct sunlight by covering with an opaque material while permitting adequate air circulation above and around the pipe.**
- 4. Store gaskets in a cool, dark place out of the direct rays of the sun, preferably in original cartons.**

### **3.3 TRENCHING AND BACKFILL**

- A. Trench excavation and backfill shall conform to the requirements of Section 31 23 33 -- Trenching and Backfilling.**

### **3.4 INSTALLATION**

- A. Lay bell-and-spigot pipe with the bell end pointing in the direction of laying.**



- B. Grade the pipe in straight lines, taking care to avoid the formation of any dips or low points.
- C. Do not lay pipe when the conditions of trench or weather are unsuitable.
- D. At the end of each day's WORK, temporarily close the open ends of pipe with wood blocks or bulkheads.
- E. Supports
  - 1. Support pipe at its proper elevation and grade, taking care to provide firm and uniform support.
  - 2. Wood support blocking will not be accepted.
  - 3. The full length of each section of pipe and fittings shall rest solidly on the pipe bed, with a recessed excavation in order to accommodate bells, joints, and couplings.
  - 4. Provide anchors and supports where indicated and where necessary for fastening WORK into place.
  - 5. Independently support fittings.
- F. Use short lengths of pipe in and out of each rigid joint or rigid structure.
- G. Replace piping that does not allow sufficient space for proper installation of jointing material with piping of proper dimensions.
- H. Blocking or wedging between bells and spigots will not be accepted.
- I. Install joints in accordance with the manufacturer's recommendations.
- J. Keep trenches free of water until joints have been properly made.
- K. The maximum combined deflection at couplings shall be in accordance with the manufacturer's recommendations.
- L. Cutting
  - 1. Cut the pipe by means of saws, power-driven abrasive wheels, or pipe cutters, which will produce a square cut.
  - 2. Cuts by wedge-type roller cutters will not be accepted.
  - 3. After cutting, bevel the end of the pipe using a beveling tool, portable type sander, or abrasive disc.
- M. Groundwater and trench water shall be kept out of the pipe and the pipe kept closed with a test plug when work is not in progress. Trenches are to be dewatered and the cost thereof included in the price for installing the pipe. All pipe shall be laid in trenches having a dry and stable bottom.
- N. Excavation may be stopped when, in the opinion of the ENGINEER, the trench is open too far in advance of the pipe laying operation. Pipe shall be fully supported along its entire length. Backfill shall be free of boulders and debris. Sharp or rocky material encountered in the base shall be replaced with proper bedding.

- O. Damaged or unsound pipe or fittings will be removed and replaced by the CONTRACTOR at no additional cost to the OWNER. Remove from the pipe all lumps, blister, excess coating material and oil prior to jointing of the pipe.
- P. Force mains are to be restrained to prevent movement of lines under pressure. Provide restrained joints at all bends, tees, crosses, wyes, plugs and main line taps. Provide support thrust blocks under all main line valves, tapping valves and tapping sleeves. All joints are to be watertight. Leaks or defects will be repaired immediately.
- Q. Pipe which has been disturbed after being laid will be taken up, the joints cleaned, and the pipe properly re-laid. Superfluous material inside the pipe must be flushed or removed by means of an approved follower or scraper after joints are made.
- R. Install fittings and pipe joints in strict accordance with the manufacturer's specifications and recommendations.
- S. Unanticipated conflicts with other underground utilities must be immediately brought to the attention of the OWNER and the ENGINEER (if applicable). Resolution of each conflict must receive prior approval from the OWNER and the ENGINEER. Any proposed deviations from the Contract Drawings must be approved by the ENGINEER and the OWNER.
- T. For sewage force mains, maintain 10' horizontal separation (outside of pipe to outside of pipe) from water mains and drainage pipes. Where 10' separation cannot be maintained between force mains and water mains, the ENGINEER may permit a lesser separation, provided restrained joint pipe is used. Maintain 15' horizontal separation from buildings, top of bank of lakes and canals, and other structures, unless otherwise approved by the OWNER.
- U. Maintain 18" vertical separation (outside of pipe to outside of pipe) between all pipes, if possible. Where 18" vertical separation cannot be maintained, the ENGINEER may permit a lesser separation, provided restrained joint pipe and fittings are used.
- V. Miscellaneous Installation Conditions
1. New connections to existing mains are to be made using proper specials and fittings to suit the actual conditions. Verify all pipe dimensions before ordering special fittings and couplings.
  2. Locate existing in-line fittings and valves prior to starting trench work on a line to be connected to an existing fitting or valve. Line tie-ins are to be done on a date and at a time approved by the OWNER.
  3. All connections to existing mains shall be made under the direct supervision of the OWNER. Valves on existing mains shall be operated only by the OWNER's personnel.
- W. Thrust Blocks
1. In addition to full mechanical restraint, concrete reaction or thrust blocks may be used for supplemental restraint at fittings, and plugs. Concrete reaction or thrust blocks shall be placed between the fittings and the side of the trench in accordance with the details shown in the Contract Drawings. Fittings and plugs are not to be encased in concrete.

2. Thrust blocks are to remain uncovered until inspected and approved by the OWNER. At all thrust blocks, visqueen protection of plugs and bolts shall be provided.

**X. Concrete**

1. Provide ready-mixed concrete for thrust blocks, encasements, and protective slabs having a 28-day compressive strength not less than 2,500 psi.

**3.5 INSTALLATION OF COPPER WIRE**

- A. Provide polyvinyl chloride pipelines with No. 10 AWG bare copper wire, laid along the top of the pipe and held in place with ties or hitches of the same kind of wire and spaced not more than 13 feet apart, or metallic locating tape laid along the centerline of the pipe trench at a depth of 18 inches below finish grade.
- B. Furnish manufacturer's literature, completely describing the tape proposed to be furnished.
- C. No tape shall be used prior to receipt of written approval of the ENGINEER.

**3.6 SERVICE CONNECTIONS**

- A. Direct tapping will not be accepted.
- B. Use double-strap bronze service clamps for service connections.
- C. Provide service clamps with a bearing area of sufficient width along the axis of the pipe such that the pipe will not be distorted when the saddle is made tight.
- D. Cutting
  1. Use an internal shell cutter to drill through the corporation stop in order to minimize PVC shavings, retain the coupon, and reduce stress.
  2. Cuts by single-fluted shell cutters or twist drills will not be accepted.
  3. Lubricate the cutting and tapping edges of the tool with cutting lubricant.
  4. Make the cuts slowly, use the follower very lightly, and do not force the cutter through pipe wall.
  5. Provide the shell cutter with sufficient throat depth to handle the heavy-wall PVC pipe.
  6. Maximum outlet size permitted with service clamps or saddle is 2-inches.
- E. Tapping Sleeves
  1. Use tapping sleeves and valves for outlet sizes greater than 2 inches in diameter.
  2. Assemble and install tapping sleeves in accordance with the manufacturer's recommendations.

**3.7 FIELD TESTING AND DISINFECTION**

- A. Field testing and disinfection of water mains shall conform to the requirements of Section 01 74 30 – Pressure Pipe Testing and Disinfection.

END OF SECTION

PBCWJD  
REVISION DATE – 03/31/2017

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