

SECTION 02150
BYPASS PUMPING

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Contractor shall furnish, construct, maintain and operate bulkheads, plugs, hoses, piping, and pumps to bypass sewage flow while maintenance or construction operations are in progress. The flow shall be diverted by pumping around the construction location to a downstream manhole. Bypass pumping shall prevent backup or overflow onto streets, yards and unpaved areas or into buildings, adjacent ditches, storm sewers, and waterways, without diverting sewage outside of the sewer system.
- B. Related Work Specified Elsewhere:
 - Section 02651, Television Inspection.
 - Section 02760, Cleaning of Sewers.
 - Section 02770, Pipe Lining.

1.2 QUALITY ASSURANCE

- A. The bypass system shall meet the requirements of all codes and regulatory agencies having jurisdiction. The Contractor shall be responsible for damage due to sewer backup or overflow onto streets, yards and unpaved areas or into buildings, adjacent ditches, storm sewers, and waterways.
- B. Some sewer flow data is available for Contractor's review upon request.

1.3 SUBMITTALS

- A. Submittals shall conform to the requirements herein.
- B. The Contractor shall submit, prior to installation, a detailed plan and description outlining all details and provisions of the temporary bypass pumping system. The plan shall be specific and complete, including such items as schedules, locations, elevations, capacities of equipment, materials and all other incidental items necessary and/or required to insure proper operation of the bypass pumping system, including protection of the access and bypass pumping locations from damage due to the discharge flows, and compliance with the requirements and permit conditions specified in these Contract Documents. Nobypass pumping shall begin until all provisions and requirements have been reviewed and approved by the City of Massillon Engineer.
- C. The bypass pumping plan shall include, but not be limited to, the following:
 - 1. Staging areas for pumps;
 - 2. Flow stoppage system, including pipe and channel plugging method and types of plugs;
 - 3. Number, size, material, location and method of installation of pump suction piping;
 - 4. Number, size, materials, method of installation and location of installation of discharge piping;
 - 5. Number, size, materials, method of installation and location of installation of all valves;
 - 6. Bypass pump sizes, capacity, number of each size to be on site and power requirements;

7. Calculations of static lift, friction losses, and flow velocity (pump curves showing pump operating range shall be submitted);
8. Size and location of standby power generator, if required;
9. Downstream discharge plan;
10. Any thrust and restraint block sizes and locations;
11. Any temporary pipe supports and anchoring required;
12. Calculations for selection of bypass pumping pipe size;
13. Schedule and for installation of and maintenance of bypass pumping lines;
14. Plan indicating location of bypass pumping line locations;
15. Method of noise reduction.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Design piping, joints, and accessories to withstand at least twice the maximum system pressure or 50 psi, whichever is greater.
- B. Pumps shall be self-priming type or submersible electric, in good working order, with a working pressure gauge. All power must be supplied by the Contractor. All pumps used must be constructed to allow dry running for extended periods of time to accommodate the cyclical nature of sewer flows.
- C. Contractor shall provide one stand-by pump equal to the capacity of the largest pump on site.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL AND MAINTENANCE

- A. Any time the bypass pumping system is operating, an experienced operator shall be on site to monitor the operation, adjust pump speed, valves, etc., make minor repairs to the system and report problems.
- B. During bypass pumping, do not allow sewage to be leaked, dumped, or spilled in or onto any area outside of the existing sewer system.
- C. In the event of accidental spill or overflow, immediately stop the discharge and take action to clean up, disinfect the spill and promptly notify the Owner.
- D. Prevent back-up of sewage in sewer laterals within the areas of pipe being rehabilitated.
- E. In the event of rain, the Contractor shall coordinate the operation of bypassing with the Owner.
- F. The Contractor shall design his bypass pumping operation to handle all flows when bypass pumping. The Contractor is responsible for timing lining operations for dry weather conditions. Wet weather flows may significantly exceed peak dry weather flows.
- G. Spare parts for each type of pump and piping shall be kept on site as required.
- H. The bypass pumping operation shall be demonstrated to the satisfaction of the Engineer and Owner prior to starting rehabilitation work.

3.2 **INSTALLATION AND REMOVAL**

- A. Contractor shall locate his bypass pipelines to minimize any disturbance to existing utilities and shall obtain approval of the pipeline locations from the Owner.
- B. During all bypass pumping operation, the Contractor shall protect existing structures and equipment from damage inflicted by any equipment. The Contractor shall be responsible for all physical damage to the existing structures and equipment caused by human or mechanical failure. The Contractor is responsible for replacing any part of the manhole damaged during the bypass operation.
- C. When working inside existing structures, the Contractor shall exercise caution and comply with OSHA requirements when working in the presence of gases, combustible or oxygen-deficient atmospheres, and confined spaces.
- D. The Contractor is responsible for excavation and dismantling the manhole to allow the proper area for the bypass operation. Upon completion of the work, the Contractor shall restore the manhole to its original condition, and backfill the excavation according to the requirements of the agency having jurisdiction.
- E. Bypass pumping and piping equipment shall be located on property and easements owned by the Owner. If additional property is required for operation and access to the Contractor's bypass pumping operation, the Contractor shall obtain written permission and agreements from the property owner and submit copies of the agreement to the Owner.
- F. The pipeline must be located off streets and sidewalks and on shoulders of the roads. When the bypass pipeline crosses streets and driveways, the Contractor must place the bypass pipelines in trenches and cover with temporary pavement. Upon completion of the bypass pumping operations, and after the receipt of written permission from the Owner, the Contractor shall remove all the piping, restore all property to pre-construction condition and restore all pavement.
- G. When bypass pumping operations are complete, piping shall be drained into the sewer prior to disassembly.
- H. Noise reduction shall be required if bypass pumping is located within 300 feet of an occupied structure. The method of noise reduction shall be approved by the Engineer. Noise reduction shall result in a sound level of no more than 70 dBA at a distance of 30 feet from the pumps.

END OF SECTION

SECTION 02651
TELEVISION INSPECTION

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Contractor shall provide all labor, materials, tools, equipment and incidentals as shown, specified, and required to perform Post- Installation television (TV) inspection of the influent sewer, as specified herein.

1.2 DEFINITIONS

- A. Survey TV Inspection: Video inspection of sewer lines to determine existing conditions of the pipe. Survey TV Inspection has already been performed by the Owner.
- B. Pre-Installation TV Inspection: Video inspection of sewer lines specified for rehabilitation to confirm cleaning and constructability of line rehabilitation.
- C. Post-Installation TV Inspection: Video inspection to determine that rehabilitation of an existing sewer or construction of new sanitary sewers has been completed according to Specifications.

1.3 SUBMITTALS

- A. Submit the TV equipment manufacturer's operating manual and guidelines to the Owner and Engineer for review. Strictly follow such instructions unless modified by the Owner or Engineer.
- B. Submit three (3) copies of CD-ROMs, DVDs and TV Inspection logs, in a bound report, to the Owner or Engineer for review.
 - 1. Provide CD-ROMs or DVDs of a quality sufficient for the Owner or Engineer to evaluate the condition of the sewer, locate the sewer service connections, and verify cleaning. If the Owner or Engineer determines that the quality is not sufficient, Contractor shall re-televise the sewer segment and provide a new CD-ROM or DVD and report at no additional cost to the Owner. Camera distortions, inadequate lighting, dirty lens, or blurred/hazy picture will be cause for rejection of a tape and rejection of the associated line segment. Payment for televised inspection will not be made until Owner or Engineer approves the quality of the CD-ROM, DVD and reports.
 - 2. CD-ROM or DVD submitted become the property of the Owner.
 - 3. Contractor shall maintain a master copy of all CD-ROMs, DVDs and TV Inspection Reports submitted, until final acceptance of contract.
 - 4. The Post-Installation CD-ROMs or DVDs shall not be edited.

PART 2 – PRODUCTS

2.1 TELEVISION EQUIPMENT

- A. Closed Circuit TV Equipment: Select and use closed-circuit television equipment that will produce a color CD-ROM or DVD.
- B. Pipe Inspection Camera: Produce a CD-ROM or DVD using a pan-and-tilt, radial viewing, pipe inspection camera or a hand-held video camera that pans ± 275 degrees and rotates 360 degrees. Use an accurate footage counter to measure the exact distance of the camera from the centerline of the starting point. Use a camera with camera height adjustment so that the camera lens is always centered at one-half the inside diameter, or higher, in the pipe being televised. Provide a lighting system that allows the features and condition of the pipe to be clearly seen. A reflector in front of

the camera may be required to enhance lighting in humidity conditions. The camera shall be operative in 100 percent humidity conditions. The camera, television monitor and other components of the video system shall be capable of producing a minimum 500-line resolution colored video picture. Picture quality and definition shall be to the satisfaction of the Engineer. If unsatisfactory, equipment shall be removed and no payment made for an unsatisfactory inspection.

- C. Television Inspection Logs: Prepare printed location records to clearly identify the location of each source of infiltration or defect discovered using a standard stationing system. Other data of significance includes:
 - 1. Estimation of extraneous flows observed from holes, joints, cracks, and from the annular space between rehabilitated sliplined pipe.
 - 2. Unusual conditions.
 - 3. Roots.
 - 4. Cracked or collapsed sections.
 - 5. Sags or low spots in the pipe.
 - 6. Presence of scale and corrosion.
 - 7. Structural deficiencies.
 - 8. Signs of previous leakage.
 - 9. Sewer line sections that the camera failed to pass through and reasons for the failure.
 - 10. Other discernible features.
- D. Data shall be recorded and a copy of the television inspection logs shall be supplied to the Owner or Engineer in the form of a bound report. A table listing acronyms and their meaning shall be included in the report. Contractor shall also supply the Owner a copy of the television inspection logs on an electronic file that is Microsoft Excel compatible.
- E. Photographs: Take instant developing 35 mm, or other standard size photographs off the TV monitor of problem areas as directed to document defects, and unusual, questionable, or severe conditions found during the course of the Work.
- F. Digital Video Disc: Provide digital video of the information in DVD format.
 - 1. Two labels are required. One label shall be placed on the front of the CD-Rom or DVD and one place on the CD-ROM or DVD case. Permanently label each CD-ROM or DVD with the following information:
 - a. Spine of tape or CD-ROM or DVD case:
 - 1) File Number.
 - 2) Contractor's Name.
 - 3) Inspection Type: Pre or Post-Installation.
 - 4) Tape Number.
 - 5) Date Televised.
 - 6) Date Submitted.
 - b. Face of tape or front of CD-ROM or DVD:
 - 1) File Name/Description.
 - 2) Pipe Diameter.
 - 3) Pipe Length.

PART 3 – EXECUTION

3.1 TELEVISION

- A. Immediately after cleaning, televise the sewer line to document its condition and to locate existing points of infiltration or other defects. Notify the Owner and Engineer 24 hours in advance of any TV inspection so that the Owner and Engineer may observe inspection operations. If conditions are shown that preclude the proper liner installation, even with cleaning, the Contractor shall notify the Owner and Engineer immediately.
- B. Perform TV inspection of the sewer as follows:
 - 1. Perform Survey TV Inspection immediately after cleaning.
 - a. Move the camera through the line in either direction at a uniform rate, stopping when necessary to ensure proper documentation of the sewer's condition.
 - b. Use manual winches, power winches, TV cable and powered rewinds or other devices that do not obstruct the camera view or interfere with proper documentation of the sewer conditions to move the camera through the sewer line.
 - c. Quantify visible leakage of extraneous flow into the sewer or other sags or defects in the sewer and record on electronic log and audio/video recording. The video recording may be paused during observation. Record results of the flow observed on CD-ROM, DVD and inspection logs..
 - 2. Perform Pre-Installation TV Inspection immediately after line cleaning and before line rehabilitation work. Pre-Installation TV Inspection is not required for sewer lines designated as remove and replace. Verify that the line is clean and ready to accept the line rehabilitation material. Maintain copies of CD-ROMs or DVDs and logs for reference by the Owner or Engineer for the duration of the Project.
 - 3. Perform Post-Installation TV Inspection to confirm completion of rehabilitation work or proper installation of new sewers. Verify that the rehabilitation work or new sewer construction conforms to the requirements of the Specifications. Provide a color videotape showing the completed Work. Prepare and submit a log providing location of any discrepancies.
 - 4. Camera shall pan beginning and ending manholes to demonstrate that all debris has been removed. Camera operator shall slowly pan clamped joints, and when pipe material transitions from one material to another. A log shall be completed for every segment that is submitted to the Owner.
 - 5. Whenever non-remote powered and controlled winches are used to pull the television camera through the line, telephones, radios, or other suitable means of communication shall be set up between the operators positioned at the two manholes of the sewer lines being inspected to ensure that good communications exist between members of the crew.
 - 6. The accuracy of the measurements for location of defects and service connections cannot be stressed too strongly. Marking on cable, or the like, which would require interpolation for depth of manhole, will not be allowed. Measurement meters shall be accurate to two-tenths of a foot over the entire length of the sewer line section being inspected. Prior to recording the location of defects and service connections, slack in the cable of the television

inspection camera shall be taken up to assure metering device is designating proper footage. Accuracy of the measurement meters shall be checked daily by use of a walking meter, roll-a-tape, or other suitable device.

3.2 **FLOW CONTROL**

- A. There shall be no flow in the line while performing Pre-Installation TV Inspection.
- B. No flow will be allowed in the line while performing Post-Installation TV Inspection.

3.3 **PASSAGE OF TV CAMERA**

- A. Do not pull or propel the television camera through the line at a speed greater than 30 feet per minute for Pre- and Post-Rehabilitation TV Inspection.
- B. For Post-Installation TV Inspection, exercise the full capabilities of the camera equipment to document the completion of the rehabilitation work or proper installation of the new sewers. and the conformance of the Work to the Specifications. Provide a full 360-degree view of pipe and joints.

3.4 **FIELD QUALITY CONTROL**

- A. Contractor shall not allow, under any circumstances, sewage or solids removed in the cleaning process to be released onto streets or into ditches, catch basins, storm drains, or storm sewer manholes, or cleanouts.
- B. Acceptance of sewer cleaning work is contingent upon the successful completion of the TV inspection. If the TV inspection shows debris, solids, sand, grease, or grit remaining in the line, the cleaning will be considered unsatisfactory. Repeat cleaning, inspection, and televising of the sewer line until cleaning is satisfactory.

3.5 **ACCEPTANCE OF WORK**

- A. Rehabilitation or completion of new sewer installation work shall only be accepted if no defects are found in the line upon TV inspection as determined by the Owner.
- B. Contractor shall repair all defects to the piping in a manner acceptable to the Owner at no additional cost to the Owner.

END OF SECTION

SECTION 02760
CLEANING OF SEWERS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Contractor shall provide all labor, materials, tools, equipment and incidentals as shown, specified, and required to clean the pipelines.
- B. The cleaning work required includes, but is not limited to, the following:
 - 1. field locating all manholes along the sewer reaches to be cleaned;
 - 2. cleaning of existing sanitary sewers, as hereinafter specified, to permit proper television inspection, installation of liner, and other rehabilitation techniques;
 - 3. disposal of waste and sediment as specified herein;
 - 4. removal of roots as specified herein;
 - 5. cleaning up as the Work progresses and after the completion of all Work activities; and
 - 6. all other work required for the complete and satisfactory cleaning of the pipeline.
- C. Related Sections:
 - 1. Section 02150, Bypass Pumping.
 - 2. Section 02651, Television Inspection.
 - 3. Section 02770, Pipe Lining.

1.2 REQUIREMENTS

- A. The Contractor shall take precautions recommended by the manufacturer and all other precautions necessary in handling of root treatment chemicals. Chemical root treatment material to be used in strict compliance with all applicable federal, state and local requirements relative to type of material and usage thereof.
- B. Take precautions to protect sewer mains and manholes from damage that might be inflicted by the improper selection of the cleaning process or improper use of the equipment. When using hydraulically propelled devices, take precautions to ensure that the water pressure created does not cause damage or flooding to public or private property. Do not surcharge the sewer beyond the elevation that could cause overflow of sewage into area waterways, homes, or buildings, or onto the ground.
- C. While video of the sewers are available, the images are approximately two years old. The Contractor is responsible for determining current conditions for estimating amount of cleaning that may be required.

1.3 SUBMITTALS

- A. Submit the following to Engineer for review:
 - 1. Plan for disposal of debris and sediment removed from the sewer lines.
 - 2. Specifications for the sewer cleaning equipment to be used on the project.
 - 3. Specifications for the equipment to be used to remove sediment and debris at the downstream manhole of each reach to be cleaned.

PART 2 - PRODUCTS

2.1 CLEANING EQUIPMENT

- A. All sewers shall be cleaned with truck-mounted, high velocity, hydro-cleaning equipment. The Contractor shall remove all unsound materials, debris, and grease by cleansing the interior surface using a minimum of 2,000 psi water spray pressure wash.
- B. Provide equipment capable of removing all sand, dirt, rocks and other debris from the sewer reach to allow unobstructed remote television internal inspection of all internal surfaces, and other rehabilitation techniques.
- C. All cleaning equipment, including machines, devices, and tools required for the entire cleaning operation shall be owned or leased and operated by the Contractor. The Contractor shall certify that backup cleaning equipment is available and can be delivered to the Site within 24 hours.
- D. Any blockages of lateral building connections resulting from the cleaning or other items of Work shall be removed by cleaning of the building connection by the Contractor, at his own expense. Any damage caused by flood of lateral building connections shall be corrected by the Contractor, at his own expense.
- E. Contractor shall provide all equipment capable of mechanically removing roots. Devices shall include a root saw, spring blade root cutter chuck or approved equal.
- F. Hand-held pressure washers with a minimum of 1,000 psi of pressure may be used.

PART 3 - EXECUTION

3.1 CLEANING

- A. After determining the preliminary requirements and the feasibility of effective video inspection, the Contractor shall thoroughly clean all pipeline reaches in order to permit an unrestricted inspection by closed circuit television. Particular emphasis shall be afforded the removal of accumulated grease, roots, sand, rocks, sludge and other debris so that the video inspection will show clearly all portions of the pipe being inspected. Acceptance of pipeline cleaning shall be made upon the successful completion of the television inspection and shall be defined as removing sufficient material to ensure an effective rehabilitation of the pipeline, to the satisfaction of the Engineer. If television inspection shows the cleaning to be unsatisfactory, the Contractor shall reclean and reinspect the pipeline at no additional cost to the Owner.
- B. Contractor is responsible for obtaining necessary permits for obtaining water from Aqua Ohio, Inc. Contractor is responsible for following all rules and requirements of the Water Department. Backflow preventers shall be used to prevent contamination of the potable water system. The Contractor is responsible for any damage resulting from improper operation of hydrants. Do not use or obstruct a fire hydrant when there is a fire in the area. Remove water meters, fittings and piping from fire hydrants at the end of each working day.
- C. Do not waste water from the public water supply because of improper connections or from hydrants left opened. If the Engineer or Owner determines that the Contractor is wasting water, the Owner may elect to charge the Contractor for water used on the project.
- D. The Contractor shall remove all bricks, rocks, debris, sludge, dirt, sand, grease, roots and other materials from the sewers to be cleaned, and collect and remove the resulting debris from the downstream manholes of the sewer section being cleaned. Passing waste material between manholes will not be permitted. When necessary,

temporarily install a dam trap or weir and in the downstream manhole in such manner that debris and solids shall be trapped and retained for subsequent removal.

- E. Remove waste and debris cleaned from the sewers at the downstream manhole by pumps or other means. The discharge and drainage stream shall be returned to the sewer and discharged downstream for disposal. Under no circumstances shall sewage or solids be dumped onto the ground surface, street, or into ditches, catch basins or storm drains. All solids and semi-solids shall be placed in a covered watertight container so that no spillage or leakage will occur and covered to minimize odors, and shall be disposed of by the Contractor. The Contractor is responsible for all operations and costs associated with removal, transportation, tipping and disposal of debris collected during the cleaning operations.
- F. Where access to manholes in easements and rights-of-way is required, the Contractor will obtain permission for access for his equipment.
- G. The Contractor shall conform to the following requirements:
 - 1. Cleaning of upstream reaches of sewers shall be completed before the downstream reaches are cleaned;
 - 2. Hydro-cleaning equipment shall be inserted in the downstream manhole of the reach, and the cleaning work shall proceed upstream; and
 - 3. Winching equipment used shall not damage the existing pipelines.

END OF SECTION

SECTION 02770

PIPE LINING

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Contractor shall provide all materials, equipment, labor and supervision for the installation and testing of pipe lining. The pipe lining will be installed in pipes made of various materials.
- B. Related Sections:
 - 1. Section 02150, Bypass Pumping.
 - 2. Section 02651, Television Inspection.
 - 3. Section 02760, Cleaning of Sewers.
 - 4. Section 03602, Sliplining Grout - Structural

1.2 QUALITY ASSURANCE

- A. Reference Standards: Comply with applicable provisions and recommendations of the following:
 - 1. ASTM D2321, Practice for Underground Installation of Flexible Thermoplastic Pipe for Sewers and Other Gravity Flow Applications.
 - 2. ASTM 3035, Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on a Controlled Outside Diameter.
 - 3. ASTM D 3350, Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
 - 4. ASTM F 585, Practice for Insertion of Flexible Polyethylene Pipe into Existing Sewers.
 - 5. ASTM F 714, Specification for Polyethylene (PE) plastic pipe (SDR-PR) Based on Outside Diameter.
 - 6. ASTM F 1417, Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low Pressure Air
 - 7. PPI Handbook of Polyethylene Pipe.
 - 8. AASHTO Standard Specification for Highway Bridges.
 - 9. ASTM D543 - Test Method for Resistance of Plastics to Chemical Reagents.
 - 10. Standards of American Water Works Association, AWWA.
 - 11. Standards of American National Standards Institute, ANSI.
 - 12. ASTM D2990 - Long-term Flexural and Tensile Modulus of Elasticity.
 - 13. ASTM D1784 - Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
 - 14. ASTM D2152 -Test Method for Degree of Fusion of Extruded Poly(Vinyl Chloride) (PVC) Pipe and Molded Fittings by Acetone Immersion
 - 15. ASTM D2241 - Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR)
- B. Contractor shall be licensed and/or certified by the manufacturer of the sliplining system and shall meet other experience requirements as listed. Only commercially proven products and installers with substantial track records will be approved. Products

and installers seeking approval must document an ability to meet the following criteria to be deemed commercially proven:

1. For a product to be considered commercially proven, a minimum of 1,000,000 linear feet or 4,000 manhole-to-manhole line sections of successful wastewater collection system installations in the U.S. must be documented to the satisfaction of the Owner to assure commercial viability. Of that, 50,000 LF must be 26-inches and larger.
 2. For an Installer to be considered as commercially proven, the installer must satisfy all insurance, financial, and bonding requirements of the Owner, and must have had at least 5 (five) years active experience in the commercial installation of the product. Acceptable documentation of these minimum installations must be submitted to the Owner.
 3. Sewer rehabilitation products submitted for approval must provide third party test results supporting the long term performance and structural strength of the product and such data shall be satisfactory to the Owner. No product will be approved without independent third party testing verification.
 4. The Contractor's Superintendent who will perform the work under this Section must have at least 3 years of experience and have successfully installed at least 300,000 linear feet of the proposed product, of which at least 5,000 linear feet must be 36-inch or greater.
- C. The Contractor shall be capable of providing all crews and equipment as needed to complete the work when directed without undue delay.
- D. Though the process may be licensed, no change of material, design values, or procedures may be made during the course of the Work without the prior written approval of the Engineer.
- E. The Contractor shall use sliplining materials provided by a single manufacturer. The supplier shall be responsible for conforming to all test requirements specified herein as applicable. In addition, all liners to be installed under this Contract may be inspected at the plant for compliance with these specifications by an independent testing laboratory provided by the Owner, at its own expense. The Contractor shall require the manufacturer's cooperation in these inspections. The cost of plant inspection will be the responsibility of the Owner.
- F. At the time of manufacture, each lot of liner shall be inspected for defects and tested in accordance with applicable ASTM standards. At the time of delivery, the liner shall be homogeneous throughout, uniform in color, free of cracks, holes, foreign materials, blisters, or deleterious faults.
- G. Care shall be taken in shipping, handling and storage to avoid damaging the liner. Extra care shall be taken during cold weather construction. Any liner damaged in shipment shall be replaced as directed by the Engineer.
- H. While stored, the sliplining materials shall be adequately supported and protected. The sliplining materials shall be stored in a manner as recommended by the manufacturer and as approved by the Engineer.
- I. For testing purposes, a production lot shall consist of all liner having the same marking number. It shall include any and all items produced during any given work shift and must be so identified as opposed to previous or ensuing production.
- J. All sliplining work shall be fully guaranteed by the Contractor and manufacturer for a period of one year from the date of acceptance. During this period, all serious defects discovered by the Owner shall be removed and replaced in a satisfactory manner at no

cost to the Owner. The Owner may conduct an independent television inspection, at its own expense, of the lining work at any time prior to the completion of the guarantee period.

- K. The Engineer may at any time direct the manufacturer and the Contractor to obtain compound samples and prepare test specimens in accordance with the applicable ASTM standards. The Contractor shall provide certified test results of the short-term properties, including wall thickness, flexural strength and flexural modulus of the cured lining material from a flat plate sample, conforming to Article 3.6.A of this Section. Samples shall be prepared and tested by an independent laboratory approved by the Engineer. The cured liner samples shall be tested for flexural strength and flexural modulus properties in accordance with ASTM F1216, ASTM D790, ASTM M638 and ASTM D2990. The samples shall meet or exceed the physical properties stated in this specification. Conformance certification shall be submitted to the Engineer for approval as part of the acceptance requirements.
- L. The newly installed liner shall be designed for a minimum 50-year service life under continuous loading conditions. Design of the liner shall be based on the condition of the existing pipe as classified by the Engineer. The liner design is the responsibility of the Contractor. The liner shall be designed by a registered professional engineer in the State of Ohio and shall have sufficient wall thickness to withstand the anticipated external pressures and loads which will be imposed after installation. The design of the liner shall include considerations for ring bending, deflection, combined loading, buckling, and ovality. Calculations which determine wall thickness requirements of the liner shall be submitted to the Engineer for information only, to assure that the requirements of the specifications have been complied with. Designs shall be based on the use of standard flexible pipe equations, as defined in ASTM and shall account for the effects of ovality. A safety factor of at least two shall be utilized. The short-term modulus of elasticity shall be reduced by 50 percent in the calculations. Where ovalities exceed 10 percent, alternate design methodologies shall be used and shall show design meets structural requirements.

1.3 **DESCRIPTION**

- A. The process shall consist of inserting a plastic pipe into an existing sewer, holding the pipe in place and grouting the annular space between the host pipe and the liner.
- B. The liner pipe shall be designed for and a structurally sound pipe with a uniformly smooth interior providing hydraulic flow equal to or greater than the existing sewer in original condition.

PART 2 - PRODUCTS

2.1 **MATERIALS**

- A. High Density Polyethylene (HDPE) Pipe
 - 1. Be manufactured of high-density polyethylene resin in accordance with ASTM D3350-06 with a cell classification of 345464C.
 - 2. Have a material designation of PE 3408 by the Plastic Pipe Institute.
 - 3. Meet stiffness range as shown in ASTM F714, Appendix X1, Table X1.1
 - 4. Have physical properties in accordance with polyethylene material standard ASTM D3350-06 with cell classification 345464C as follows:
 - a. Density: 0.955 gms/cubic centimeters per ASTM D1505.
 - b. Flexural Modulus: Minimum 135,000 psi per ASTM D790.

- c. Tensile Strength: Minimum 3,200 psi per ASTM D638.
 - d. PENT > 100 hours at 80 degrees C, 2.4 Mpa per ASTM F1473.
 - e. HDB@ 23 degrees C: 1,600 psi per ASTM D2837.
 - f. UV Stabilizer: Minimum 2% carbon black per ASTM D 1603.
- 5. Liner pipe for host pipe 24-inch ID and larger shall be DR 32.5
 - 6. Liner pipe for host pipe 20-inch and smaller shall be DR 17
 - 7. Liner pipe shall be smooth and non-porous with a Manning friction coefficient "n" of 0.009 or a Hazen Williams friction coefficient "C" of 150.
- B. Fusible Polyvinyl Chloride (FPVC) Pipe
- 1. Fusible polyvinylchloride pipe shall conform to ASTM D3034 or ASTM F679.
 - 2. Fusible polyvinylchloride pipe may instead conform to AWWA C900 or AWWA C905, and/or ASTM D2241 or ASTM D1785 for IPS standard dimensionality, if applicable. Testing shall be in accordance with AWWA standards for any of these pipe types.
 - 3. Rework material shall be allowed per ASTM D3034, ASTM F679, AWWA C900 or AWWA C905 standards.
 - 4. Fusible polyvinylchloride pipe shall be extruded with plain ends. The ends shall be square to the pipe and free of any bevel or chamfer. There shall be no bell or gasket of any kind incorporated into the pipe.
 - 5. Fusible polyvinylchloride pipe shall be manufactured in a standard 20', 30' or 40' nominal length.
 - 6. Fusible polyvinylchloride pipe shall be green in color for wastewater use.
 - 7. Pipe generally shall be marked per AWWA C900 or AWWA C905, and shall include as a minimum:
 - a. Nominal pipe size
 - b. PVC
 - c. Dimension Ratio, Standard Dimension Ratio or Schedule (omit for ASTM D3034 or ASTM F679 pipe)
 - d. Extrusion production-record code
 - e. Trademark or trade name
 - f. Cell Classification 12454 and/or PVC material code 1120 may also be included.
 - 8. Pipe shall be homogeneous throughout and be free of visible cracks, holes, foreign material, blisters, or other visible deleterious faults.
 - 9. Liner pipe for host pipe 24-inch ID and larger shall be DR 32.5
 - 10. Liner pipe for host pipe 20-inch and smaller shall be DR 17
 - 11. Liner pipe shall be smooth and non-porous with a Manning friction coefficient "n" of 0.009 or a Hazen Williams friction coefficient "C" of 150.

2.2 **JOINTING**

A. Fusion Joints

1. Fusible joints shall be assembled in the field with butt-fused joints.
2. Contractor shall follow the pipe supplier's guidelines for this procedure.
3. Pipe shall be handled in a safe and non-destructive manner before, during, and after the fusion process and in accordance with this specification and pipe supplier's guidelines.
4. Pipe shall be fused by qualified fusion technicians, as documented by the pipe supplier.
5. Each fusion joint shall be recorded and logged by an electronic monitoring device (data logger) affixed to the fusion machine.
6. Only appropriately sized and outfitted fusion machines that have been approved by the pipe supplier shall be used for the fusion process.
7. Fusion machines shall incorporate the following properties, including the following elements:
 - a. **HEAT PLATE** - Heat plates shall be in good condition with no deep gouges or scratches. Plates shall be clean and free of any debris or contamination. Heater controls shall function properly, cord and plug shall be in good condition. The appropriately sized heat plate shall be capable of maintaining a uniform and consistent heat profile and temperature for the size of pipe being fused, per the pipe supplier's guidelines.
 - b. **CARRIAGE** – Carriage shall travel smoothly with no binding at less than 50 psi. Jaws shall be in good condition with proper inserts for the pipe size being fused. Insert pins shall be installed with no interference to carriage travel.
 - c. **GENERAL MACHINE** - Overview of machine body shall yield no obvious defects, missing parts, or potential safety issues during fusion.
 - d. **DATA LOGGING DEVICE** - The current version of the pipe supplier's recommended and compatible software shall be used. Datalogging device operations and maintenance manual shall be with the unit at all times. If fusing for extended periods of time, an independent 110V power source shall be available to extend battery life.
8. Other equipment specifically required for the fusion process shall include the following:
 - a. Pipe rollers shall be used for support of pipe to either side of the machine.
 - b. A weather protection canopy that allows full machine motion of the heat plate, fusion assembly and carriage shall be provided for fusion in inclement and /or windy weather.
 - c. Fusion machine operations and maintenance manual shall be kept with the fusion machine at all times.
 - d. Facing blades specifically designed for cutting fusible polyvinylchloride pipe shall be used.

9. Joint Recording
 - a. Each fusion joint shall be recorded and logged by an electronic monitoring device (data logger) connected to the fusion machine.
 - b. The fusion data logging and joint report shall be generated by software developed specifically for the butt-fusion of thermoplastic pipe.
 - c. The software shall register and/or record the parameters required by the pipe supplier and these specifications.
 - d. Data not logged by the data logger shall be logged manually and be included in the Fusion Technician's joint report.

B. Buttress Lock Joints

1. "Buttress-Loc" pipe allows short lengths of pipe to be assemble inside a manhole effectively converting short lengths of plastic pipe into continuous pipelines.
2. Each length is screwed together with a chain wrench that when fully tightened, automatically self seals.
3. Completed joint shall exhibit very high pull out strength without changing the OD or the ID of the liner pipe.
4. Liner pipe shall be advanced into the host pipe as the joints are completed.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Review survey television inspection tapes of the sewer line to plan rehabilitation work. Contractor shall be responsible for determining the location of all active sanitary services prior to lining.
- B. The work of pipeline cleaning shall conform to the requirements of Section 02760, Cleaning of Sewers.
- C. Contractor shall provide for continuous sewage flow around the section of sewer that is to be lined in accordance with Section 02150, Bypass Pumping.
- D. Inspect and confirm the inside diameter, alignment and condition of the pipeline. Contractor shall confirm the data and information collected from this inspection to verify the size of the liner and refine the installation techniques. If unknown physical conditions in the work area are uncovered during the investigation that materially differ from those ordinarily encountered, the Contractor shall notify the Engineer.
- E. Inform the Engineer of work schedules for sliplining installation.
- F. Conduct operations in accordance with applicable OSHA standards, including those safety requirements involving work on an elevated platform and entry into a confined space. Make suitable precautions to eliminate hazards to personnel near construction activities when pressurized air is being used.

3.2 PRE-INSTALLATION CLEANING AND TV INSPECTION

- A. Contractor shall clean the pipeline in accordance with Section 02760, Cleaning of Sewers, prior to lining the existing pipe.
- B. Contractor shall conduct TV Inspection, prior to lining in accordance with Section 02651, Television Inspection.

3.3 **OBSTRUCTION REMOVAL, POINT REPAIR AND SAG ELIMINATION**

- A. Necessary point repairs to facilitate lining shall be the responsibility of the Owner. Contractor shall notify the Owner immediately after the pre-installation cleaning and TV inspection where point repairs are necessary to facilitate installation of the liner.
- B. Notify the Engineer if the pre-installation video inspection reveals an obstruction in the line segment (such as heavy solids, dropped joints, protruding service connections or collapsed pipe) that cannot be removed by conventional sewer cleaning equipment and if the obstruction will prevent completion of the inversion.

3.4 **BYPASS PUMPING**

- A. Bypass pumping systems shall be in accordance with Section 02150, Bypass Pumping.

3.5 **INSTALLATION PROCEDURES**

- A. General
 - 1. Liner shall be installed by pulling or pushing.
 - 2. Precautions shall be taken to protect the liner from scratches or gouges.
 - 3. Liner shall be protected from rough edges of the host pipe.
 - 4. Liner shall be equipped with suitable spacers to allow installation and ensure proper placement of the liner pipe in the host pipe.
 - 5. Liner shall be allowed to relax and come to thermal equilibrium before sealing the annular space between the liner and the host pipe.
 - 6. Liner shall extend into manhole.
- B. Excavation and Access Pits
 - 1. Access pit length shall be determined by the material and jointing method selected by the Contractor.
 - 2. The minimum bending radius for the pipe as recommended by the supplier shall be maintained.
 - 3. Sheet piling, shoring and bracing requirements shall be in accordance with these specifications and applicable jurisdictional standards.
 - 4. Confined space requirements shall be in accordance with OSHA regulations.
 - 5. Access pit excavations shall be performed at all points where the slipline pipe will be inserted into the existing pipeline.
 - 6. When possible, access pit excavations shall coincide with host pipe lateral connection points or other appurtenance installations.
- C. Pulling Equipment
 - 1. The pulling mechanism shall be properly connected to the end of the pipe via a pulling head or arrangement approved by the pipe supplier.
 - 2. The maximum pulling tension on the pipe shall not exceed the pipe supplier's safe pulling force as submitted for this project.
- D. Pushing Equipment
 - 1. An end protector plate shall be attached for hydraulically pushing or winching completed sections further into the sewer from manhole to manhole.
 - 2. Routine shall be carried out until the entire pipe insertion is finished.

- E. Pipe Care
 - 1. The pipe shall be handled with care to minimize the possibility of it being cut, kinked, gouged, or otherwise damaged. The use of cables or hooks will not be permitted.
 - 2. Sections of the pipe damaged, cut, or gouged shall be repaired by cutting out the section of damaged pipe and rejoining.

3.6 **FIELD QUALITY CONTROL**

- A. Field acceptance of the liner shall be based on the Engineer's evaluation of the installation including TV video and a review of certified test data for the installed pipe samples.
 - 1. Groundwater infiltration of the liner shall be zero.
 - 2. There shall be no evidence of splits, cracks, breaks, lifts, kinks, delaminations or crazing in the liner.
 - 3. If any defective liner is discovered after it has been installed, it shall be removed and replaced with either a sound liner or a new pipe at no additional cost to the Owner.
- B. Repair failed lining or lining deemed unacceptable as a result of post-installation television inspection or test reports for structural values, thickness, or other defects. Obtain approval of the Engineer for method of repair, which may require field or workshop demonstration.

3.7 **SEALING AT MANHOLES**

- A. Form a tight seal between the sliplining and the manhole wall at the pipe penetration.
- B. Liner pipe shall be allowed to relax and come to thermal equilibrium for 24 hours prior to sealing.
- C. Do not leave any annular gaps.
- D. Seal the annular space to permanently block the flow of water into the manhole between the liner and the host pipe.
- E. Finish off the seal with an approved non-shrink grout or cementitious liner material placed around the pipe opening from inside the manhole in a band at least 4-inches wide.

3.8 **POST-TELEVISION OF COMPLETED WORK**

- A. Provide a video tape showing completed work in accordance with Section 02651, Television Inspection.
- B. All defects discovered during the television inspection shall be corrected by the Contractor before the Work under the Contract will be considered for substantial completion. After the defects are corrected, the sewer shall be video taped again.
- C. The post-rehabilitation television inspection tape shall be submitted to the Engineer in sufficient time to allow the Engineer to review the video tape prior to substantial completion.

3.9 **FINAL CLEANUP**

- A. Upon completion of rehabilitation work and testing, Contractor shall clean and restore the entire project area affected by the Work.
- B. All excess material and debris not incorporated into the permanent installation shall be disposed of in accordance with local regulations.

- C. Sidewalks, driveways and street surfaces shall be cleaned and returned to a condition similar to that before the work started.

END OF SECTION

SECTION 03602
SLIPLINING GROUT - STRUCTURAL

PART 1 – GENERAL

1.1 DESCRIPTION

Contractor shall provide all materials, labor and equipment necessary to completely fill the annular space between the slipliner pipe and the host pipe with high-strength (> 3000 psi) cementitious grout.

1.2 QUALITY ASSURANCE

- A. ASTM C138 Test Method for Unit Weight, Yield and Air Content (Gravimetric) of Concrete
- B. ASTM C939 Standard Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method)
- C. ASTM C942 Standard Test Method for Compressive Strength of Grout for Preplaced-Aggregate Concrete in the Laboratory
- D. ASTM C1090 Standard Test Method for Measuring Changes in Height of Cylindrical Specimens from Hydraulic-Cement Grout

1.3 DESCRIPTION

- A. Contractor shall seal the annular space between the liner and host pipes with cementitious structural grout as shown and specified.

1.4 SUBMITTALS

- A. CONTRACTOR shall provide six (6) bound copies of the following information to the ENGINEER for review and approval prior to construction:
 - 1. Qualifications and experience of grout mix applicator and Project Superintendent and support personnel.
 - 2. Grout mix design and trial mix tests, with set time, compressive strength, viscosity, and density test results.
 - 3. Initial set time of the grout.
 - 4. The 24 hour and 28 day minimum grout compressive strengths.
 - 5. The grout working time before a 15% change in density or viscosity occurs.
 - 6. The proposed grouting methods and procedures.
 - 7. Method for waste grout recovery.
 - 8. Estimated grout volume for each pipe.
 - 9. The maximum injection pressures proposed as well as maximum allowable grout injection pressures as provided by the pipe manufacturer (as applicable).
 - 10. Proposed grout stage volumes (if grouting is to be performed in stages)
 - 11. Bulkhead designs and locations including vent and injection port location and proposed materials to be used in bulkhead construction. In addition the lengths of each port shall be shown.
 - 12. Method of flow control during grouting

13. Detailed plans depicting the method of blocking the liner pipe down to the invert for a period of time long enough to allow the grout to set when buoyant uplift is a factor.
14. Written confirmation that the CONTRACTOR has coordinated grouting procedures with the grout installer and the liner pipe manufacturer.
15. For each different type of grout or variations in procedure of installation, a complete package shall be submitted. The submittal shall include each of the above items and the locations of conditions to which it applies.

PART 2 - PRODUCTS

- A. Provide cementitious grout consisting of a mixture of cement, water, fly ash or lime and admixtures specifically designed to meet the requirements of this Section.
- B. Use only potable water obtained from a municipal water distribution system and transported, when required, in a clean, dedicated container designed specifically for such.
- C. Admixtures shall be selected by the slip-lining grout manufacturer to meet performance requirements, improve pumpability, control set time and reduce segregation. Admixtures shall not be biodegradable.
- D. The grout shall have a minimum compressive strength of 3000 psi in 28 days when tested in accordance with ASTM C942.
- E. The grouting system shall have sufficient gauges, monitoring devices, and tests to determine the effectiveness of the grouting operation and to ensure compliance with the liner pipe specifications and design parameters.
- F. CONTRACTOR shall develop one or more mix designs to completely fill the annular space based upon, but not restricted to, the following requirements:
 1. Size of annular void
 2. Void (size) of the surrounding soil
 3. Absence or presence of water
 4. Sufficient strength and durability achieve the design requirements presented in the sliplining Specification.
 5. Provide adequate retardation for placement
 6. Provide less than 1 percent shrinkage by volume
 7. Heat of hydration compatible with pipe material in accordance with pipe manufacturer's recommendations
- G. Mixing
 1. The materials shall be mixed in equipment of sufficient size and capacity to provide the desired amount of grout material for each stage of the grouting operation.
 2. System shall mix the grout to a homogeneous consistency and deliver grout to the injection point under a normal range of operating conditions.
 3. Equipment shall be capable of mixing the grout at densities required for the approved procedures and shall also be capable of changing mixing parameters as dictated by field conditions at any time during the grouting operation.

H. Pressure Gauges

1. Pressure gauges shall be suitable for use in the grouting environment and have a working range between 1.5 to 2.0 times the design grout pressures, and have accuracy within 0.5% of full range.
2. Provide, at a minimum, one pressure gauge at the point of injection and one pressure gauge at the grout pump.

PART 3 - EXECUTION

3.1 GROUT INJECTION

- A. Notify the ENGINEER at least 24 hours in advance of grouting operations.
- B. Once the slipliner pipe has been installed, construct bulkheads at each end in sequence from upstream to downstream. Following construction of the bulkheads, the CONTRACTOR shall fill the annular space between the slipliner pipe and the host pipe along its entire length with cementitious grout by injecting grout from one end of the pipe segment, allowing it to flow toward the other end.
- C. Equip slipliner pipes with temporary weirs as necessary to fill the pipes with water to prevent flotation during grouting operations.
- D. Remove or control standing or running water in annular spaces to maintain the correct water ratio of the grout mixture.
- E. Limit pressure on the annular space to prevent damage to the liner. The gauged grout pressure at the pipe shall not exceed that of the pipe manufacturer's recommendation or 5 psi, whichever is smaller. Regardless of the pressure, the CONTRACTOR shall be solely responsible for any damage or distortion to slipliner pipe due to grouting.
- F. The drilling of additional injection holes from the surface or through the liner pipe to facilitate grouting is prohibited.
- G. Injection of grout shall continue until all of the following conditions have been achieved unless otherwise approved by the ENGINEER:
 1. The estimated volume of grout has been injected
 2. The exhausted grout recovered at each vent is not less than 85% of the density of the freshly injected grout
 3. The exhausted grout at each vent is not less than 85% of the original viscosity of the freshly injected grout, and
 4. The grout installer, and/or Field Engineer recommends ceasing grouting operations
- H. No hardened grout is permitted in the liner pipe invert after completion of grouting operations.

3.2 TESTING

- A. Provide all personnel and equipment necessary to measure density in accordance with ASTM C138 or by another method as approved by the ENGINEER not less than two times per hour in the field during grouting operations.
- B. Provide all personnel and equipment necessary to measure viscosity in accordance with ASTM C939 not less than two times per hour in the field during grouting placement. The apparent viscosity shall not exceed 35 seconds unless otherwise approved by the ENGINEER.

C. Compressive Strength

1. Collect, transport, cure, test and report samples in accordance with ASTM C942.
2. Contrary to ASTM C942, collect and test specimens based on the more restrictive of the following criteria:
 - a. One (1) specimen (consisting of one, 3-gang mold) for each grouting event for each pipe collected at approximately the mid-point of the grouting operation.
 - b. One (1) specimen (consisting of one, 3-gang mold) for each 500 cubic feet of grout placed for each pipe.
3. Test all specimens for compressive strength at 28 days. Additional specimens and tests may be performed at the CONTRACTOR'S discretion.
4. CONTRACTOR shall engage the services of an independent, ASTM/AASHTO accredited testing laboratory to collect and test specimens associated with the strength requirements of this Section.

END OF SECTION