

DIVISION 5 – SANITARY SEWER SYSTEM CONSTRUCTION

5.1 WASTEWATER SYSTEM MATERIALS

5.1.1 General

All wastewater installations shall be made with new and unused pipe, pipe fittings, an appurtenances of the size, type and character outlined in the following specifications. All materials shall have been manufactured within the previous year and have invoices to show the purchase and purchase date etc. Whenever proprietary equipment is specified “or approved equal” is implied. All proposals for substitution shall be submitted in writing to the Town for approval. Where a manufactures name is used in these specifications, it is used to designate a minimum standard of quality based on the specific design characteristics of the manufacturer specified, not limited to, but including, material quality, flow characteristics, interchangeability, design features, inventory, warranty, maintenance costs, and service. Equality evaluation shall be determined not solely on whether a product is capable of doing an adequate job, but rather if a product will perform the specific job specified, as well as meeting the additional specific requirements set forth herein. The Town will be the sole judge as to whether a product shall be approved as an equal. Any product not specified in the latest modifications or revisions of the Towns written specifications and details, must have approval before shipment to projects within the Towns jurisdiction. Any product shipped without prior written approval, shall be rejected. Representative samples of materials, intended for the incorporation in the specifications of the Town, shall be submitted for examination, and/or test. A written point-by-point detailed comparison to material currently specified shall be submitted with any exceptions noted. Written warranties, along with certifications of material compliances, shall be required for all materials submitted for review. No set time limits shall be given for material review.

5.1.2 Gravity Mains

- A. Wastewater pipes and fittings shall be polyvinylchloride (PVC) SDR 26 wastewater pipe and shall meet or exceed ASTM D-3034 and/or F-679. Joints shall be gasketed, bell and spigot type with the bell made integral with the pipe.
- B. PVC pipe shall be legibly marked as follows at intervals of five feet maximum; manufacturer's name or trademark, pipe size, PVC cell classification, appropriate legend such as PVC SDR-35 ASTM D-3034, Manufacturer's lot number, date of manufacture, test pressure, and point of origin. Test results shall be available upon request.
- C. PVC pipe and fittings shall be produced by an extrusion process and shall be homogeneous throughout, free from cracks, holes, foreign materials, inclusions, ripples, screw memory, or other defects. The pipe and fittings shall be uniform in color. Pipe with blisters, bubbles, cuts, ripples, or scrapes on inside or outside surfaces, or other imperfections which impair the performance or life of the pipe, will be rejected.
- D. All pipe of a given size and material shall be furnished by the same manufacturer. Standard lengths shall be 20 ft and not lay less than 14 feet +/- 1 inch except for manhole stubs. All PVC pipe and fittings shall have the National Sanitation Foundation (NSF) seal of approval. All PVC pipe shall be manufactured by North American Pipe Corp. or approved equal.

- E. Flexible Coupling (FERNCO). Flexible couplings composed of elastomeric PVC shall conform to ASTM C443, C425, C564 and D1869 as manufactured by Fernco, Inc. Each coupling shall be supplied with four Type 305 stainless steel adjustable clamps. Only Stainless steel shielded connections are acceptable, Fernco Strong Back RC Series Repair Couplings or approved equal.

5.1.3 Manholes

{See DETAIL 7}

- A. Manholes shall be Precast reinforced concrete capable of sustaining an H-20 loading and meeting standards put forth under ASTM C-478. Manholes shall have a minimum inside diameter of 48 inches with a Minimum wall thickness of five inches. Concrete strength shall be 4000 PSI minimum at 28 days and wire reinforcement 4x12 – W4/W2.1 shall be used.
- B. Manhole bases shall be standard precast manhole with poured in place concrete or monolithic flanged bottom section placed above base layer – CR-6, GAB, clean aggregate, etc. The base section shall be monolithic to a point 12 inches above the crown of the incoming pipe with a minimum base thickness of 8 inches. The base shall have a diameter 16 inches larger than the barrel of the manhole. Manhole bench shall slope toward the channel at a rate of fall between 0.5 in./ft. and 1.0 in./ft. Pipe holes in new manholes shall be properly located and cast in place with appropriate resilient connector (star-seal, press-seal or approved equal). The resilient connector shall meet the requirements of ASTM C-923. Services into existing manholes may be cored and shall be sealed using press-seal corporation PSX direct drive or approved equal with two stainless steel bands to hold the pipe in place. Connector shall conform fully with the requirements of ASM C 923, ASTM C 1478, and ASTM F 2510.
- C. Cone sections shall be eccentric narrowing from 48 inches to 24 inches inside diameter (or 60 inch to 24 inch for 5 foot manholes). Flat top sections shall be used in place of a cone section for manholes less than 5 feet deep. The 24-inch access hole shall be offset to allow easy access to steps and shall be reinforced to support H-20 loading.
- D. For all manholes the external surface shall be coated with coal tar epoxy from the frame down past the joint between the cone and top riser section. For drop manholes and for manholes accepting a forced main and the next manhole down from the forcemain receiving manhole the interior surface shall be coated with Parsonpoxy SEL-80 High Build Epoxy Coating or equal which shall be applied to the manufacturers specifications. The exterior of the manhole from the frame and cover down to the cone section shall be coated with parsonpoxy or and minimum epoxy tar coating.
- E. Manhole steps conforming to the applicable provisions of ASTM Specifications C-478 shall be factory built into precast sections. Step spacing and alignment to be maintained uniform and vertical throughout the depth of the manhole and steps should not be more than 16” apart.
- F. Joints of the manhole sections shall be of the tongue and groove type; sections shall be joined using methods which meet or exceeds all requirements of ASTM C990 Standard Specification for joints, concrete pipe, manholes and precast box sections, using Preformed Flexible Joint Sealants. Sealing gasket shall be equal to RAM-NEK as manufactured by Henry Company, Sealants Division of Houston, Texas. All joints, holes, etc., shall be sealed with epoxy mortar.

- G. The finished product shall be smooth and uniform without any cracks, chips, voids, air pockets or other defects. Manholes shall be supplied by C.R. Semler, inc. (Smithsburg, MD), or approved equal.

5.1.4 Manhole Frame and Covers

{See DETAIL 9}

- A. Manhole frame and cover shall be heavy duty type made of CL35B Cast Iron and meet a heavy duty load rating HS-25, the clear opening of the frame shall be 24" in diameter, The cover shall be 2 3/8" in thickness and 25 7/8 in diameter and the words "SANITARY SEWER" and "Town of Boonsboro shall be cast into the top of the cover. The Frame shall be the 1545Z3 Model and the Cover shall be the 1544 C model as produced by The EJ Group Inc in the USA.
- B. Frames shall be drilled or cast with holes for anchor bolts. All manhole cover frames shall be securely attached to the manhole by use of anchor bolts.
- C. The joint between the frame and the precast manhole section shall be provided with preformed plastic joint sealing material equal to Rub'R-Nek as manufactured by K.T. Snyder Company, Inc. of Houston, TX, or approved equal, and shall be watertight. No mortar joints will be permitted.
- D. Castings shall be manufactured true to pattern. Component parts shall fit together in a satisfactory manner without binding. Castings shall be smooth and well cleaned by shot blasting. Metal shall be ASTM-A-48 class 35B gray iron and castings shall have a minimum tensile strength of 35,000 psi and meet a HS-25 loading.
- E. An HDPE anti-inflow dish as produced by parsons environmental shall be provided and installed in all manhole frames that are not of the water tight variety.
- F. Watertight frames and covers, as applicable, shall be East Jordan Iron Works or approved equal.

5.1.5 Marking Tape

Underground marking tape shall be a (4" width), detectable marking tape, with a minimum 5.0 mil overall thickness. Tape shall be manufactured using a 0.8 mil clear virgin polypropylene film, reverse printed and laminated to a 0.35 mil solid aluminum foil core, and then laminated to a 3.75 mil clear virgin polyethylene film. Tape shall be printed using a diagonally striped design for maximum visibility, and meet the APWA Color-Code standard for identification of buried utilities. Detectable marking tape shall be Pro-Line Safety Products or approved equal and made in the USA. Green and Silver with black lettering, Labeled "Wastewater" or "Sewer Line".

5.1.6 Casings:

- A. Casing shall be steel unless approved otherwise. The steel casing pipe shall have a minimum yield strength of 35,000 psi, have a thickness as required but not less than 0.375 inches, be equipped with grout holes and conform to AWWA C200 and ASTM A53.

- B. Casing interior and exterior shall be painted with two coats bitumastic enamel coating in accordance with AWWA C203.
- C. Insulators shall be installed on the carrier pipe and end seals on the casing pipe. Refer to Detail 10 on the use of end seals on the casing, spacing of the insulators, and the cavity seal (between the inside diameter of the casing and the outside diameter of the pipeline). Casing insulators and end seals shall conform in design to Model 60 insulators and Multiflex molded end seals as manufactured by Maloney Pipeline Products Company, T.D. Williamson, Inc., or an approved equal.
- D. Minimum casing diameter shall be in accordance with the Town Detail, and MD SHA requirements as applicable.

DIVISION 6 – WASTEWATER SYSTEMS CONSTRUCTION METHODS

6.1 PRECONSTRUCTION REQUIREMENTS

The developer or his/her authorized representative is required to file for local and state permission to construct if the diameter of the wastewater main exceeds 15" or if the work involves a pump station or force main. Within the flood plain of any live stream, etc., a waterway construction permit should be obtained by the developer or his authorized representative; this includes above ground structures as well as wastewater pipelines. The Maryland Town of the Environment (MDE) should be contacted for more information.

For any Street cutting the contractor or other representative of the developer/owner is responsible to file for a permit with either the city, county or state prior to construction. Additional permits required which are associated with the provision of wastewater service include building, plumbing and use and occupancy permits. A demolition permit may be required depending on conditions. Blasting permits are also required if blasting activities are to be undertaken.

6.2 General

The following requirements are regulations pertaining to all wastewater collections system extensions constructed.

All sewer construction projects shall meet the requirements of the Maryland Department of the Environment, osha, and the Maryland Department of Labor, Licensing, and Regulation, and shall conform to the requirements contained herein.

Sanitary wastewater systems are to be provided solely for the removal of sanitary wastewater. Under no circumstances shall any roof drains, foundation drains, surface or subsurface drains be either directly or indirectly connected to wastewater pipelines. The following design parameters include an adequate allowance for normal infiltration but will not accommodate the above forbidden connections.

6.3 Pipeline Installation

6.3.1. Excavation:

- A. The trench shall be excavated to a depth of six inches below the outside diameter of the pipe barrel, or deeper if so specified. The width of the trench shall be as shown on the detail drawings. All of this excavation may be done by machine. The resultant subgrade shall be undisturbed, or compacted as approved by the Engineer if disturbed.
- B. When the pipe is to be laid in fill, bring the fill to two feet above the elevation of the top of pipe to be laid before excavation commences. Compact fill to 95% of the maximum density as determined by ASTM D1557-70 or AASHTO T-180, Method D (Modified Proctor). The bottom of the trench shall be compacted to 95% of maximum density prior to installation of the pipe bedding.

6.3.2. Bedding:

- A. The pipe shall be bedded on 6 inches of AASHTO No. 7 stone, the full width of the trench, and shall be covered with AASHTO No. 7 stone to a height of 12 inches over the top of the pipe.
- B. The bedding shall be thoroughly compacted to 95% of maximum density. The bedding shall provide uniform and continuous bearing and support for the pipe at every point between the bells.
- C. Unstable Subgrade.

(1) Where the bottom of the trench at subgrade is found to be unstable or to include ashes, cinders, any type of refuse, vegetable, or other organic material, or large pieces or fragments of inorganic material, which, in the opinion of the Town, should be removed, the Applicant shall excavate and remove such unsuitable material to the width and depth recommended by the Town. Before pipe is laid, the subgrade shall be formed by backfilling with AASHTO No. 7 stone in 3-inch (uncompacted thickness) layers thoroughly compacted to 95% of maximum density and the bedding prepared as hereinbefore specified.

(2) Flowable Backfill meeting the requirements of MD SHA Specifications for Construction & Materials Section 314 may be used as an alternative to backfilling with stone. Material consists of a mixture of cement and water which shall have a 28-day unconfined minimum compressive strength of 100 psi based on the manufacturer's certification, and shall be placed in accordance with the manufacturer's recommendations.

D. If potentially corrosive materials are encountered, polyethylene encasement shall be installed to protect ductile iron pipe in accordance with ANSI/AWWA C105/A21.5.

E. Special Foundations.

Where the bottom of the trench at the subgrade is found to consist of material which is unstable to such a degree that, in the opinion of the Town, it cannot be removed and replaced with an approved material thoroughly compacted in place to support the pipe properly, a suitable foundation for the pipe shall be designed and submitted to the Town for approval.

F. Concrete Encasement.

Pipes to be encased in concrete shall have minimum six inches of concrete above and below the pipe and the concrete shall be extended for the full width of the natural trench. No formwork to limit the concrete width shall be used. Flexible pipe joints shall be provided in the pipe at a distance of three times the pipe diameter from the ends of the concrete encasement, to provide pipe articulation. Pipes shall be protected against flotation during placement of concrete encasement. This may require two stage concrete placement combined with anchor straps.

G. Bracing and Shoring - Bracing and/or shoring shall be used to insure safe conditions during after construction. All trenches greater than six feet in depth shall be braced unless benching is utilized. Excavation wall support may be required under certain circumstances for manhole or pump station construction.

6.3.3. Laying Pipe:

A. PVC pipe and fittings shall be installed in accordance with the requirements of the manufacturer and ASTM D2321. No more than 10% of a section of sewer between two manholes shall consist of laying lengths less than 10 feet. All pipes shall be laid to a uniform line and grade, bell ends upgrade, with a firm and even bearing along the barrel of the pipe. The spigot end of the pipe is to be centered in, shoved tight and secured against the bell of the previously laid pipe. The interior of each pipe shall be cleaned of all foreign material before the next pipe is laid. Pipe laying shall commence at the lowest point and proceed upgrade. All pipe shall be laid without a break, upgrade from structure to structure, with the bell ends of the pipe upgrade. Pipe shall be laid to the line and grade given so as to form a close concentric joint with the adjoining pipe and prevent sudden offsets of the low line. At each joint in the pipe, the pipe subgrade shall be recessed in firm bedding material so as to relieve the bell of the pipe of all load and to ensure continuous bearing along the pipe barrel. At the close of each day's work, and at such other times when pipe is not being laid, the open end of the pipe shall be closed by a watertight plug or other approved means.

B. Grade and Alignment Control.

Prior to construction, three copies of a grade sheet for each manhole run shall be furnished to the Town. Grade and alignment control shall be established by laser or surveying equipment.

C. Pipe Clearance in Rocks.

- (1) Ledge rock, boulders and large stones shall be removed to provide a clearance of at least 6 inches below and on each side of all pipe and fittings for pipes 24 inches in diameter or less, and 9 inches for pipes larger than 24 inches in diameter.
- (2) The specified minimum clearances are the minimum clear distances which will be permitted between any part of the pipe and/or fitting being laid and any part, projection or point of rock, boulder or stone.

C. Pipes at Manholes or Other Rigid Structures.

Pipes directly connected to or supported by rigid structures (manholes, vaults, wall, etc.), shall not have a length beyond the rigid support in excess of that shown in the detail drawings. Two flexible joints shall be required within three pipe diameters of a rigid structure.

6.3.4. Backfilling:

A. The trench may be filled with excavated material above the AASHTO No. 7 or No. 10 stone as specified above except that stones larger than eight (8) inches may not be placed in the trench and the fill shall not contain more than 20% stone in total volume.

- B. The trench shall be properly tamped in lifts not to exceed the maximum thickness for the type of tamping equipment being used. All bedding and backfilling shall be compacted to 95% of maximum density as determined by ASTM D1557-70 or AASHTO T-180, Method D (Modified Proctor). Backfilling shall not be done with frozen material. No backfilling shall be done if the material already in the trench is frozen.
- C. Utility excavations in areas of streets, access drives, parking areas and loading areas shall be backfilled in accordance with the foregoing requirements with the following exception the trench shall be filled with concrete, flowable fill, CR-6 or GAB stone above the AASHTO No. 7 pipe bedding. Aggregates shall be placed and compacted to the foregoing requirements.
- D. In State highways, all backfill shall be in accordance with the requirements of MD SHA.
- E. Special attention shall be made to properly compact the pipe haunching area.
- F. Wastewater Warning Tape - Green/Silver detectable tape with the words " CAUTION SEWER LINE BURIED BELOW" imprinted in black every four feet shall be placed two feet above the wastewater line during backfill as indicated in standard details.

6.3.6. Bored Crossings:

- A. All construction methods and materials proposed for use in tunneling, jacking or boring shall be submitted to and approved by the Town prior to construction. The encasement pipe shall be installed with even bearing throughout its entire length, and shall slope to one end with the same slope as the sewer pipe. Spacers shall be used to center and align the pipe in the casing per the detail. The ends of the casing pipe shall be sealed as shown in the standard detail drawings.

6.4 Manhole Installation

6.4.1. General:

Watertight manhole frames and covers are to be used whenever the manhole is subject to flooding or is located within the 100-year flood plain.

Manholes located along streams, creeks, or other bodies of water shall be required to be extended above the 100-year flood plain.

Manholes located within an easement shall be extended minimum of 10 inches above ground level.

All wastewater pipelines shall have a minimum 0.1 feet drop through the manhole. Where wastewater pipelines change direction, the invert elevation shall drop a minimum of 0.25 feet through the manhole.

6.4.2. Bases.

Install bases on an 8-inch deep compacted layer of aggregate meeting requirements of Pipe Bedding as specified previously in the wastewater mains section.

When using prefabricated pipe opening seals (i.e., Star Seal by Vertex Inc.) for connecting pipes into manholes, and such seals create an annular space on interior and exterior of manhole wall pipe openings after pipe connection is made, fill such annular spaces with preformed flexible plastic sealing compound.

- (1) Tightly caulk sealing compound into annular spaces in a manner to completely fill the spaces and render the installation watertight.
- (2) Following sealing compound installation, trowel compound surface smooth and flush with interior face of manhole.

6.4.3. Concrete Channel Fill.

A. Field pour concrete channel fill for each manhole base.

- (1) Form inverts directly in concrete channel fill.
- (2) Accurately shape invert to a semi-circular bottom conforming to inside of connecting pipes, and steel trowel finish to a smooth dense surface.
- (3) Make changes in size and grade gradually.
- (4) Make changes in direction of entering sewer and branches to a true curve of as large a radius as manhole size will permit.
- (5) Make slopes gradual outside the invert channels.

B. Use 4,000 psi Type II Portland Cement concrete unless indicated otherwise on Detail drawings.

6.4.4 Setting Manholes

Per the Recommended Installation Procedures for Manholes per NPCA (National Precast Concrete Association).

- A. Lifting Apparatus: Use approved lifting slings that will adequately lift weight of units. The use of an approved or rated spreader bar is preferred. When lifting manhole bases and risers, make sure chain or cable lengths are long enough to prevent contact with tongue and groove area, and are kept at appropriate lifting angles. Use wooden blocks between sling and manhole wall if necessary.
- B. Recommended Manhole Bedding: Use a minimum of 6" of approved bedding material compacted to 90% proctor in an area not less than base area but preferably 6" beyond the outside radius on manhole base. The area under incoming and outgoing pipes should be treated the same to prevent shearing of pipes. Local ground conditions may require additional bedding thickness, per Engineer's recommendations.

- C. Setting Manhole Base: Set manhole base on graded bedding per job specifications making sure boots or pipe openings match design elevations. Level top of manhole base in both directions.
- D. Pipe Connections: (Per manufacturer's recommendations) check with manufacturer if precast inverts are supplied.
1. Cast in place gaskets (star seal, press seal or approved equal) should normally be used and installed by the manhole manufacturer. Seal gaps with epoxy mortar.
 2. Compression Type Connector - Cut 3/4" bevel on end of pipe to be inserted into manhole. Clean pipe surface and inside area of connector. Lubricate inside of connector and exterior of area of pipe being inserted with approved lubricant. Center beveled end of pipe into connector. Keeping pipe level, push pipe into connector until pipe is flush with inside of manhole wall or as required per local specifications. Seal gaps with epoxy mortar.
 3. Pipe Stubs: Any pipe stubs installed in the Manhole must be restrained from movement to prevent blowout resulting from ground water or any testing.
- E. Joint Installation:
- Ram-Nek Gasket
1. Apply one brush coat of RAM-NEK Primer to concrete surfaces to be sealed. (Primer is recommended but not required unless conditions are wet).
 2. Remove protective wrapper on one side only of preformed RAM-NEK strip or coil and press firmly to the dry, clean joint surface. Leave the outside wrapper in place to protect the gasket and keep it from stretching.
 3. Remove protective wrapper from RAM-NEK gasket and set next section. Each unit is forced "home" by its own weight, compressing RAM-NEK to tightly pack and immediately seal the joint. "Squeeze out" is visible proof of a watertight joint.
- Butyl Gasket - Use only manufacturer recommended sizes for specific diameters. Clean and inspect tongue and groove surfaces. Surfaces should be free of all dust and debris. On tongue-up manhole, place butyl material next to the vertical surface of tongue. Wrap material completely around unit overlapping ends. Knead the ends together to form a unified splice. Make sure ALL protective paper is removed. Lower bell end of next section making sure steps are aligned (if applicable) into final position. If Bell is up, place butyl material next to vertical surface of groove and follow above procedure.
- Confined O-Ring - Clean and inspect joint surfaces. Lubricate joint surface liberally. Lubricate O-Ring gasket thoroughly before placing into confined groove space provided. Run a smooth round object between gasket and tongue around entire circumference several times. Lower lubricated end of next section making sure steps are aligned into final position. Keep sections level/plumb while setting to prevent rolling gasket and breaking bell.
- Offset and Prefabricated Gaskets - Install per manufacturer's specifications.
- F. Precast Lift Hole Sealing (full penetration): Lifting holes shall be sealed by inserting a rubber plug or other approved material, into hole (if supplied) and/or filling with non-shrink mortar from inside & outside then with epoxy tar.
- G. Backfill Procedure: before backfilling. Detecting leaks at this time is easy and repairs are simple. Backfill around manhole equally to prevent tipping. Compact fill in lifts same as standard trench procedure. Backfill material should be clean and free of large rocks.
- H. Testing Procedures: Refer to THE Testing section for the NPCA Manhole Vacuum Testing Brochure for vacuum, hydrostatic, and pressure testing.

6.4.5 Infiltration and Inflow Protection

All Manholes and cleanouts shall be located in such a manner as to prevent inflow (surface runoff) from entering the wastewater system. Manhole inserts are required for new installations.

DIVISION 7 – WASTEWATER SYSTEMS TESTING

7.1 Pipe lines and Appurtenances Testing

Testing is required prior to acceptance by the department of all new gravity pipe lines and force mains. 48 hour prior notice is required.

7.1.1 Leakage Test

Gravity sewer PVC pipe shall be air tested per ASTM F 1417 – “Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air”. Per this specification, testing pressures are regulated between 3.5 to 4.0 psig with a maximum allowable test pressure of 9 psig. It is not recommended that air-testing pressures exceed this limit due to worker safety issues. The gauge shall have adequate resolution to accurately show the change in pressure. Generally, the pressure within the pipe line section under test (including plugged laterals if applicable) shall be stabilized at 4.0 pounds per square inch (PSI) and held for a minimum of 4 minutes. If less than a 1 psi drop occurs during the test period, the line section is considered good. Otherwise, the leak shall be isolated and repaired prior to retesting. Occasionally, depending on specific circumstances, the pressure retention criteria in will be used to verify the integrity of a waste water line segment. The air test may be waived for less than a full length of pipe.

7.1.1. Allowable Deflection Test

A. Pipe deflection measured not less than 30 days after the backfill has been completed as specified shall not exceed 5 percent. Deflection shall be computed by multiplying the amount of deflection (nominal diameter less minimum diameter when measured) by 100 and dividing by the nominal diameter of the pipe.

B. Deflection shall be measured with a rigid mandrel (Go/No Go) device cylindrical in shape and constructed with a minimum of nine evenly spaced arms or prongs. Drawings of the mandrel with complete dimensions shall be submitted to the Engineer for each diameter of pipe to be tested. The mandrel shall be hand pulled through all sewer lines. Provide certification that these tests have been conducted to the Town. These tests must be witnessed and approved by the Engineer or Town.

C. Any section of sewer not passing the mandrel shall be uncovered at no additional cost to the Owner and the bedding and backfill replaced to prevent excessive deflection. Repaired pipe shall be retested at no additional cost to the Owner. Retested pipe shall not deflect more than 4 percent.

Flushing and Screening: All completed pipelines shall be flushed in the presence of an inspector from the Department. A screen shall be placed on the downstream end of the pipeline to collect any foreign materials. Flushing flow and velocity shall be sufficient to remove all foreign material from the pipe line.

Video Inspections: Plastic pipes shall be video inspected prior to installation to document they are defect free. After installation and final flushing and screening, all finished pipelines shall be Video Inspected. The recording shall be fully documented with the location, pipe size, manhole,

and line identification. The recording shall be in color and of quality and lighting to accurately document the condition of the interior of the pipe. The video shall be recorded onto DVD for documentation by the Department. Typically the Department will conduct the final video inspections. All video inspections shall be made by a certified PACP operator:

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MINIMUM SPECIFIED TIME REQUIRED FOR A 0.5 PSIG PRESSURE DROP FOR SIZE AND LENGTH OF PVC OF DI PIPE INDICATED FOR Q=0.0015

| 1 Pipe Diameter (in.) | 2 Minimum Time (min.: sec) | 3 Length for Minimum Time (ft) | 4 Time for Longer Length (sec) | Specification Time for Length (L) Shown (min:sec) | | | | | | | | |
|-----------------------------|-------------------------------------|--|---|---|--------|---------|---------|--------|--------|---------|---------|--------|
| | | | | 100 ft | 150 ft | 200 ft. | 250 ft. | 300 ft | 350 ft | 400 ft. | 450 ft. | |
| 4 | 1:53 | 597 | .190L | 1:53 | 1:53 | 1:53 | 1:53 | 1:53 | 1:53 | 1:53 | 1:53 | 1:53 |
| 6 | 2:50 | 398 | .427L | 2:50 | 2:50 | 2:50 | 2:50 | 2:50 | 2:50 | 2:50 | 2:50 | 2:50 |
| 8 | 3:47 | 298 | .760L | 3:47 | 3:47 | 3:47 | 3:47 | 3:47 | 3:47 | 3:47 | 4:26 | 5:04 |
| 10 | 4:43 | 239 | 1.187L | 4:43 | 4:43 | 4:43 | 4:57 | 5:56 | 6:55 | 7:54 | 8:54 | 9:54 |
| 12 | 5:40 | 199 | 1.709L | 5:40 | 5:40 | 5:42 | 7:08 | 8:33 | 9:58 | 11:24 | 12:50 | 14:16 |
| 15 | 7:05 | 159 | 2.671L | 7:05 | 7:05 | 8:54 | 11:08 | 13:21 | 15:35 | 17:48 | 20:02 | 22:16 |
| 18 | 8:30 | 133 | 3.848L | 8:30 | 9:37 | 12:49 | 16:01 | 19:14 | 22:26 | 25:38 | 28:51 | 32:03 |
| 21 | 9:55 | 114 | 5.235L | 9:55 | 13:05 | 17:27 | 21:49 | 26:11 | 30:32 | 34:54 | 39:16 | 43:38 |
| 24 | 11:20 | 99 | 6.837L | 11:24 | 17:57 | 22:48 | 28:30 | 34:11 | 39:53 | 45:35 | 51:17 | 57:00 |
| 27 | 12:45 | 88 | 8.653L | 14:25 | 21:38 | 28:51 | 36:04 | 43:16 | 50:30 | 57:42 | 64:54 | 72:07 |
| 30 | 14:10 | 80 | 10.683L | 17:48 | 26:43 | 35:37 | 44:31 | 53:25 | 62:19 | 71:13 | 80:07 | 89:01 |
| 33 | 15:35 | 72 | 12.926L | 21:33 | 32:19 | 43:56 | 53:52 | 64:38 | 75:24 | 86:10 | 96:57 | 107:43 |
| 36 | 17:00 | 66 | 15.384L | 25:39 | 38:28 | 51:17 | 64:06 | 76:55 | 89:44 | 102:34 | 115:23 | 128:12 |
| 42 | 19:54 | 57 | 20.942L | 34:54 | 52:21 | 69:49 | 87:15 | 104:42 | 122:10 | 139:37 | 157:04 | 174:31 |
| 48 | 22:47 | 50 | 27.352L | 45:35 | 68:23 | 91:11 | 113:58 | 136:46 | 159:33 | 182:21 | 205:09 | 227:56 |
| 54 | 25:31 | 44 | 34.618L | 57:42 | 86:33 | 115:24 | 144:15 | 173:05 | 201:56 | 230:47 | 259:38 | 288:29 |
| 60 | 28:20 | 40 | 42.738L | 71:14 | 106:51 | 142:28 | 178:05 | 213:41 | 249:18 | 284:55 | 320:32 | 356:09 |

Note: If there has been no leakage (zero psig drop) after one hour of testing, the test section shall be accepted and the test complete.

Manholes Testing

Vacuum tests shall be conducted on newly constructed manholes following construction & after all connections have been made. Successful testing shall be accomplished before any backfilling operations and after backfilling and completing the installation.

The vacuum test shall be conducted by plugging all incoming and outgoing wastewater pipelines in the manhole at a location beyond the connection of the wastewater pipelines with the manhole. All plugs shall be blocked in place so as not to move during the test. The vacuum testing collar shall be inflated in the frame in accordance with the equipment manufacturer's recommendations.

A vacuum of ten (10) inches of mercury shall be drawn and the vacuum pump turned off and the valve between the vacuum pump and the vacuum gauge shall be turned off. The time period which is taken for the vacuum to fall from ten (10) inches of mercury to nine (9) inches of mercury shall be determined. If the time taken for the vacuum to reduce the ten inches (10") of mercury to nine inches (9") of mercury is less than the time indicated in the following Table, then the manhole work shall be considered not acceptable and shall be rejected. If the time is equal to or exceeds the time indicated below, the manhole work shall be accepted.

| <u>Manhole Depth (ft.)</u> | <u>Time (sec)</u> | | |
|----------------------------|-----------------------|------------|------------|
| | <u>Diameter = 48"</u> | <u>60"</u> | <u>72"</u> |
| 8 | 20 | 26 | 33 |
| 10 | 25 | 33 | 41 |
| 12 | 30 | 39 | 49 |
| 14 | 35 | 46 | 57 |
| 16 | 40 | 52 | 65 |
| 18 | 45 | 59 | 73 |
| 20 | 50 | 65 | 81 |
| 22 | 55 | 72 | 89 |
| 24 | 59 | 78 | 97 |
| 26 | 64 | 85 | 105 |
| 28 | 69 | 91 | 113 |
| 30 and greater | 74 | 98 | 121 |

All manholes shall be repaired by Contractor and retested as described above until a successful test is made. After each test, the temporary plugs shall be removed. Once all manholes have been tested, the manholes will be given a field visual inspection. The inspection shall be performed at the discretion of the Department's Inspector during the warranty period following a rainfall sufficient enough to raise the groundwater table above the possible infiltration areas. All leakage problems determined by this inspection shall be corrected by the Contractor within an agreed upon time to the satisfaction of the Department. Where necessary to complete the work, the Contractor shall be responsible for the bypassing and/or blocking of the flow in the manholes and must have prior approval by the Department.

