**SECTION 02730**

**SANITARY SEWER SYSTEM**

1. **GENERAL**
   1. **WORK INCLUDED**
      1. Work in this Section includes all gravity sanitary sewer system and sewer force main work.
      2. The work shall include the providing of all proper materials, equipment, tools, accessories, labor and services required to install the sewer system, complete-in-place, using sound standard engineering techniques and construction practices.
      3. Reference Specifications are referred to by abbreviation as follows:

ANSI - American National Standards Institute

ASTM - American Society for Testing and Materials

AWWA - American Water Works Association

VDOT - Virginia Department of Transportation (VDOT)

* + 1. Definitions
       1. Outside or exterior shall mean 5 feet beyond the perimeter of buildings, except that footing drains are included.
       2. Inside or interior shall mean inside buildings and within 5 feet of the perimeter of buildings, except that footing drains are excluded.
  1. **SEPARATION OF WATER LINES AND SANITARY AND/OR COMBINED SEWERS.**
     1. Follow PSA Standards and State Health Department "Waterworks Regulations" for separation of water mains and sewer lines. In the event of difference or conflict, the stricter standard shall govern.
     2. Parallel Installation
        1. Normal Conditions - Water lines shall be constructed at least 10' horizontally from a sewer or sewer manhole whenever possible. The distance shall be measured edge-to-edge.
        2. Unusual Conditions - When local conditions prevent a horizontal separation of at least 10', the water line may be laid closer to a sewer or sewer manhole provided that:
           1. The bottom of the water line is at least 18" above the top of the sewer.
           2. Where this vertical separation cannot be obtained, the sewer shall be constructed of AWWA ductile iron water pipe pressure-tested in place to 50 psi without leakage prior to backfilling. The sewer manhole shall be of watertight construction and tested in place.
  2. **CROSSING**
     1. Normal Conditions - Water lines crossing over sewers shall be laid to provide a separation of at least 18" between the bottom of the water line and the top of the sewer whenever possible.
     2. Unusual Conditions - When local conditions prevent a vertical separation of at least 18”, the following construction shall be used:
        1. Sewers passing over or under water lines shall be constructed of AWWA ductile iron water pipe pressure-tested in place to 50 psi without leakage prior to backfilling. The sewer manhole shall be of watertight construction and tested in place.
        2. Water lines passing under sewers shall, in addition, be protected by providing:
           1. A vertical separation of at least 18" between the bottom of the sewer and the top of the water lines.
           2. Constructing any water lines passing under sewers of AWWA ductile iron.
           3. Providing structural support for the sewer line to prevent excess deflection of the joints and settlement on and/or breaking of the water line.
           4. That the length of the water line shall be centered at the point of the crossing so that joints shall be equidistant and as far as possible from the sewer.
     3. Sewers or sewer manholes - No water pipes shall pass through or come in contact with any part of sewer or sewer manhole.

# PRODUCTS

# PIPE

* + 1. Submit shop drawings on all products as required by the PSA.
    2. Provide certified test results of pipe testing as required by the PSA.
    3. Ductile iron pipe for gravity sewer main, gravity sewer lateral, and sewer forcemain (including grinder pump laterals) shall meet requirements of AWWA/ANSI C151/A21.51 Pressure Class 350, unless otherwise indicated on the drawings or called for otherwise in the PSA standards. Ductile Iron pipe for use in sewer applications shall be have the standard cement interior lining replaced with ceramic epoxy lining at outline in 2.1 J below.
    4. Polyvinyl-Chloride (PVC) gravity sewer pipe and fittings in sizes 4” and 6" shall meet the requirements of ASTM Standard D3034 SDR 26, Type PSM with flexible elastomeric gasket seals conforming to ASTM Standard F477. Pipe shall be green without exception.
    5. Polyvinyl-Chloride (PVC) gravity sewer pipe and fittings in sizes 8" through 15" shall meet the requirements of ASTM Standard D3034 SDR 35, Type PSM with flexible elastomeric gasket seals conforming to ASTM Standard F477. Pipe shall be green without exception.
    6. Polyvinylchloride (PVC) gravity sewer pipe and fittings in sizes 18” through 48” shall meet the requirements of ASTM F679 wall thickness T-1, PS 46 with flexible elastomeric seals conforming to ASTM Standard F477. Pipe shall be green without exception.
    7. Use of HDPE pipe for gravity sewers is not permitted.
    8. All pressure pipe and fittings used for sewer applications shall comply with the requirements as outlined in Section 02665 2.0 *except as follows*:
       1. All PVC pipe shall be colored *green* without exception
       2. All HDPE pipe shall be solid *green* or black with a *green* stripe without exception
       3. All DI pipe and fittings shall have the interior cement coating replaced with a ceramic epoxy material complying with 2.1 J below.
    9. Ceramic Epoxy Lined Ductile Iron Pipe & Fittings
       1. All ductile iron gravity sewers and sewer forcemains are to be coated with a protective lining in lieu of standard cement mortar lining. All ductile pipe and fittings shall be delivered to the application facility without asphalt, cement lining, or any other lining on the interior surface. Because removal of old linings may not be possible, the intent of this specification is that the entire interior of the ductile iron pipe and fittings shall not have been lined with any substance prior to the application of the specified lining material and no coating shall have been applied to the first six inches of the exterior of the spigot ends.
       2. The coating shall be TNEMEC Perma-Shield Series 431 or approved equal.
    10. Exterior, bituminous coating for ductile iron pipe and fittings and cast iron fittings shall meet requirements of AWWA C106 or AWWA C151 as applicable.
    11. Metal harness shall be stainless steel rods and clamps.
    12. Nipples shall be constructed of materials as listed on drawings and/or details. Under no circumstances shall galvanized pipe be used.
  1. **VALVE BOXES**
     1. Valve boxes shall be adjustable cast iron valve boxes of the two-piece type, consisting of lid and two-piece sliding extension. The word "SEWER" shall be cast or embossed on the valve box lid in letters not less than 1" high. Valve box shall equal to Tyler 6850 Series with 5-1/4” drop lid.
  2. **CHECK VALVES**
     1. Check valves 3 inches and larger shall be iron body, bronze mounted, swing check valves, meeting requirements of AWWA C508. Check valves 3 through 12 inches shall be for 175 psi non-shock cold water working pressure. Valves 14 through 24 inches shall be for 150 psi non-shock cold water. Valves shall have outside weight and lever.
     2. Manufacturer shall be American Darling Valve and Manufacturing Company, Eddy-Iowa Division of Clow Corporation, Kennedy Valve Manufacturing Company, M & H Division of Dresser Industries, or G-A Industries, Inc.
  3. **PLUG VALVES**
     1. Plug valves shall be of the eccentric plug type and shall be tight closing, resilient laced, non-lubricating variety such that the valves pressure member (plug) rises off the body seat contact area immediately upon shaft rotation during the opening movement. Valves shall be drop-tight at the rated pressure (175 psi 3" through 12", 150 psi 14" and above) and shall be satisfactory for applications involving throttling service as well as frequent or infrequent on-off service. The valve closing member should rotate approximately 90 degrees from the full-open position and vice-versa. Valves shall open in a counter-clockwise direction.
     2. The valve body shall be constructed of cast iron conforming to ASTM A126, Class B. Body ends shall be either:
        1. Flanged with dimensions, facing, and drilling in full conformance with A­ ANSI B16.1, Class 125 (including flange thickness), or;
        2. Mechanical joint to meet the requirements of AWWA C111/ANSI A2l.11;
     3. as specified in the Contract Documents.
     4. Eccentric Plug Valves shall have a round or rectangular shaped port. Port areas for 3” to 20” valves shall be a minimum 100% of full pipe area. Valve 4” and larger shall freely pass a 3" diameter solid without clogging.
     5. Valve seat surface shall be welded-in overlay, cylindrically shaped of not less than 90% pure nickel. Seat area shall be raised, with raised area completely covered with weld to insure proper seat contact. The machined seat area shall be a minimum of 0.125" thick and 0.500" wide. Sprayed, plated or screwed in seats shall not be acceptable.
     6. Valve bodies shall be of ASTM A-126, Class B cast iron or ASTM A536, Grade 65-45-12 ductile iron. The plug shall have a cylindrical seating surface that is offset from the center of the plug shafts. The plug shafts shall be integral. The entire plug shall be 100% encapsulated with Buna-N rubber in all valve sizes. The rubber compounds shall be approximately 70 (Shore A) durometer hardness. The rubber to metal bond must withstand 75 pounds pull under test procedure ASTM D-429-73 Method B. Valve bodies shall be coated with epoxy on both interior and exterior.
     7. Shaft bearings, upper and lower, shall be sleeve type metal bearings, sintered, oil impregnated, and permanently lubricated type 316 stainless steel conforming to ASTM A742 Grade CF-6M. Thrust bearings shall be Nylatron.
     8. Plug valve shaft seals shall be on the multiple V-ring type (Chevron) and shall be adjustable. All packing shall be replaceable without removing the bonnet or actuator and while the valve is in service. Shaft seals shall be made of Buna-N.
     9. Each valve shall be given a test against the seat at the full rated working pressure and a hydrostatic shell test at twice the rated working pressure. Certified copies of individual tests shall be submitted when requested. Certified copies of proof-of­ design tests shall be submitted upon request.
     10. All gearing shall be enclosed, suitable for running oil seals provided on all shafts to prevent entry of dirt and water into the actuator. Actuator shall clearly indicate valve position, and an adjustable stop shall be provided to set closing torque. Valve packing adjustment on non-submerged valves shall be accessible without removing the actuator from the valve. Construction of actuator housing shall be constructed of the same material as the valve body. All exposed nuts, bolts and washers shall be zinc plated.
     11. Plug valves and actuators for submerged or buried service shall have seals on all shafts, and gaskets on valve and actuator covers, to prevent the entry of liquid. Actuator mounting brackets for submerged service shall be totally enclosed and shall have gasket seals. All exposed nuts, bolts, springs and washers for submerged valves shall be stainless steel.
     12. Gear actuators shall be of the type that can be mounted for remote operation and a high head extension, waterproof, enclosure pipe.
     13. Buried valves shall be equipped with 2" sq. operating nuts unless otherwise shown on the Drawings. Where nuts will be more than 48" below finished grade, extension stems shall be pin connected to valve stem. Extension stem shall raise operating nut to within 24" of finished grade.
     14. Interior valves 4" and smaller in size shall be wrench operated, except where otherwise shown on the Drawings. Valves shall be capable of being converted to worm gear or automated operation without removing the bonnet or plug from the valve. Valves shall be equipped with a 2" sq. nut for use with removable levers or extended "T" handles.
     15. All buried valves and any valves 6" and larger shall be right-angle, worm-gear operated. Interior valves shall be equipped with handwheel operators unless otherwise indicated on drawings. Buried valves shall be equipped as indicated above. Gear operators shall be totally enclosed, permanently lubricated. Manual operator components shall withstand, without damage, a pull of 200 lbs. on the handwheel, with buried service gear units capable of withstanding an input torque of 300 lbs. on the operating nut as required by AWWA C 504-87, Sec. 3.8.3 and AWWA C507-85, Sec. 11 Paragraph 11.9. Gear segment shall be of ductile iron, ASTM A536, Grade 65-45-12, supported on bronze bushings.
     16. Interior valves in inaccessible locations shall be provided with valve floor- stands or chain operators as shown on the drawings.
     17. Hydraulic, pneumatic or electric operators shall be provided, where shown on drawings.
     18. Valves shall be Milliken, Pratt, or Dezurik.
  4. **TAPPING SLEEVES**
     1. Tapping sleeves shall not be used on sewer forcemains except under specific approval and direction from the PSA.
  5. **COUPLINGS**
     1. Couplings for use in pressure pipe systems shall be one of the following:
        1. Use of an integral restrained coupling. Restraint are to be compatible with the pipeline materials and working pressures. Couplings are to be Romac Alpha, Megalug Series 3800, or approved equal.
        2. Use of a ductile iron mechanical joint long body solid sleeve complying with AWWA C153, pressure rating to comply with the pipeline. Sleeves shall be used with pipe restraints. The model numbers listed below are by Megalug, which is identified as the standard of quality. Other manufacturers offering products of equal quality will be considered.
           1. Restraints for ductile iron shall be Series 1100 or 1100 TDM depending on working pressure.
           2. Restraints for 4”-12” PVC shall be Series 2000PV.
  6. **FLANGED ADAPTERS**
     1. Flanged adapters for joining ductile iron plain-end pipe to flanged ductile iron items shall be Uni-Flange Series 400 or 420 or approved equal rated for the working pressure of the pipe.
  7. **PRESSURE GAUGES**
     1. Pressure gauges shall be open front case type with bronze bourdon tube soldered to socket and tip, stainless steel movement, and a 4 1/2" white coated dial graduated from 0 to 500 psi. Compound gauges shall be open front case type with bronze bourdon tube soldered to socket and tip, stainless steel movement, and a 4 1/2″ white coated dial graduated from -15 to 100 psi. Gauges shall be equipped with a valve cock and diaphragm isolator. Gauges shall be Ashcroft No. 1279 or approved equal.
  8. **COMBINATION AIR RELEASE/VACUUM VALVES**
     1. Low profile combination valves for all force main sizes and located where indicated on Contract Drawings, shall have a conical shaped, reinforced nylon body, a seal plug assembly made from light weight non-corroding reinforced nylon, Buna-N O- rings, and stainless steel floats and internal parts (springs, washers, and stem). Valves shall have a polypropylene flushing connection on the top that is easily accessible, a body drain with ball valve at the base of the body, and be rated for a working pressure of 150 psi. Valves shall be Model D-025 as manufactured by A.R.I.
  9. **MANHOLES**
     1. Manholes shall be constructed of pre-cast reinforced concrete manhole sections in accordance with the requirements of ASTM C478 and detailed in Standard Details.
     2. A maximum of two lift holes per manhole section may be provided.
     3. Provide tongue and groove type joints in manhole sections with a pre-formed groove in the tongue for placement of sealing gaskets.
        1. Bituminous mastic shall comply with requirements of ASTM C990 and C443.
        2. Gaskets shall provide the sole element in sealing the joint from either internal or external hydrostatic pressure.
     4. Provide flexible pipe connections to manholes, other than acid-resistant manholes, shall be sealed with a flexible boot. The port shall be cored or cast to the size, shape, surface finish, and location required. Connectors shall be suitable for field repair or replacement. Connectors not suitable for field replacement are unacceptable. Angular adjustments through 20o shall not be allowed. The flexible boot shall be a 3/8” thick neoprene compound complying with ASTM C443. The boot shall be secured to the port with an internal aluminum expanding band and to the pipe with a non-magnetic corrosion-resistant steel external band. The assembled connectors shall allow at least an 11° angular deflection of the pipe and at least one inch of lateral misalignment in any direction and be suitable for a normal variation in diameter or roundness for the pipe material used. Boot seal shall be Kor-N-Seal as manufactured by Trelleborg.
     5. Manholes shall be coated, both exterior and interior, with a protective coating. Coating shall be Conseal CS-55 by Concrete Sealants or approved equal, applied per manufacturer’s recommendation.
     6. Liners for acid-resistant manholes shall be of fiberglass reinforced polyester or polyvinylchloride construction and shall be installed to protect the pre-cast manhole sections from the inside base of the manhole to the base of the manhole frame.
        1. FRP liners shall consist of a 3/16 in. thick fiberglass reinforced polyester with a 15 mil gel coat interior surface. The polyester resin shall be similar to Dion No. 6694. Joints between sections of the liner shall be sealed in accordance with the manufacturer's instructions.
        2. PVC liners shall consist of polyvinylchloride plates, not less than 0.060 in. thick, with integral bonding ribs and shall be similar to Amercoat "T-Lock Amer-Plate". Joints between sections of liner shall be welded in accordance with the manufacturer's instructions.
     7. Sealant for manhole frames shall be a one-component polyurethane sealant similar to Sika "Sikaflex" Type 1a.
     8. Sealant for flexible pipe connections shall be a two-component polyurethane sealant similar to Sika "Sikaflex" Type 2c with primer Type 429.
     9. Manhole steps shall be corrosion-resistant and shall be rubber-covered steel. The steps shall conform to the dimensions shown in the Standard Details.
     10. Manhole frames and covers shall be molded of gray cast iron conforming to ASTM A48, Class 35. Castings shall be coated with a coal tar pitch varnish, to which sufficient oil has been added to make a smooth coating, tough and tenacious when cold, but not tacky or brittle. Seating surfaces between frame and cover shall be machined. The dimensions shall conform to the requirements shown in the Standard Details.
         1. Standard Manhole Frame and Cover shall be similar to EJ 1040Z Frame and 1040 AGS Cover
         2. Watertight Manhole Frame and Cover shall be similar to EJ Campression Assembly with the with rubber gasket as outlined in Standard Details.
     11. All manhole frames and covers shall be manufactured in the United States.
  10. **LATERALS**
      1. Sewer laterals may be made with integral sewer tees for new mains only.
      2. Sewer laterals connecting to existing mains shall be made with Inserta-Tee, Romac CB Sewer Saddle, or approved equal. Sewer laterals connecting to new mains may also use one of the above or may use integral sewer tees on the main.
      3. Laterals shall be constructed as provided in the Standard Details. All laterals shall include a cleanout in a cleanout box at the easement or property line that shall be owned by the PSA. Such public cleanouts shall be constructed per the Standard Details. Cleanout boxes shall Neenah model R-1975-A2 or approved equal.

# EXECUTION

* 1. **PIPE LAYING – GENERAL**
     1. Take all precautions necessary to insure that pipe, valves, fittings, and related items are not damaged in unloading, handling and placing in trench. Examine each piece of material just prior to installation to determine that no damage has occurred. Remove any damaged material from the site and replace with undamaged material.
     2. Keep pipe clean. Exercise care to keep foreign material and dirt from entering pipe during storage, handling and placing in trench. Close ends of in-place pipe at the end of any work period to prevent entry of animals and foreign material.
     3. Bedding of pipe shall be as specified in Section 02225 - Trenching & Backfilling and on Standard Details.
     4. Do not lay pipe when weather or trench conditions are unsuitable.
     5. All ductile iron pipe 8” in diameter and smaller and all PVC pipe 12” in diameter and smaller shall be driven home by hand.
     6. All lines shall be laid based on cut sheets.
     7. Lay gravity sewers so as to maintain a true alignment and grade as indicated on Contract Drawings. After completion, the pipe shall exhibit a full circle of light when lighted at one manhole and viewed from the next.
     8. Commence laying gravity sewers at the lowest point on a section of line and lay pipe with the bell ends uphill.
     9. Preparatory to making pipe joints on gravity sewer lines, clean and dry all surfaces of joint pipe and jointing material. Use lubricants, primers, adhesives and similar materials as recommended by the manufacturer. Place, fit, join and adjust the jointing materials or factory fabricated joints as recommended by the manufacturer to obtain the degree of watertightness required. As soon as possible after the joint is made, place sufficient backfill material, as specified under Trenching & Backfilling section of these specifications, along each side of the pipe to resist forces that might tend to move the pipe off line and grade.
     10. Complete backfilling as specified under Trenching & Backfilling section of these specifications. Place backfill over the pipe immediately after the pipe has been laid.
     11. Install force main with a minimum depth of cover of 36 in. over the top of the pipe, where no grades are shown on the Drawings.
     12. Where grades on the force main conflict with existing pipes or structures, lay force main to additional depth with a uniform vertical curve to provide proper clearance without the use of fittings. No additional payment will be allowed for additional excavation. Provide allowance for expansion as directed by Engineer.
     13. Lay force main pipe with bell ends facing the direction of laying. Where grade is 10 percent or greater, pipe shall be laid uphill with bell ends upgrade.
  2. **JOINING MECHANICAL JOINT PIPE**
     1. Thoroughly clean inside of the bell and 8 inches of the outside of the spigot end of the joining pipe to remove oil, grit, excess coating and other foreign matter from the joint. Paint the bell and spigot with soap solution (half cup granulated soap dissolved in 1 gallon water). Slip cast-iron gland on spigot end with lip extension of gland toward end of pipe. Paint rubber gasket with or dip into the soap solution and place on the spigot end with thick edge toward the gland.
     2. Push the spigot end forward to seat in the bell. Then carefully press the gasket into the bell so that is located evenly around the joint. The gland is moved into position, bolts inserted and nuts screwed up finger tight, then tighten all nuts to torque listed below. Contractor shall provide a calibrated torque wrench for verification of torque.

Bolt Size - Inches Torque Ft. - Lbs.

|  |  |
| --- | --- |
| 5/8 | 40 - 60 |
| 3/4 | 60 - 90 |
| 1 | 70 - 100 |
| 1¼ | 90 - 120 |

* + 1. Tighten nuts on alternate sides of the gland until pressure on the gland is equally distributed.
    2. Permissible deflection in mechanical joint pipe shall not be greater than listed in AWWA C600.
  1. **JOINING PUSH-ON JOINT PIPE**
     1. Thoroughly clean inside of the bell and 8” of the outside of the spigot end of the joining pipe to remove oil, grit, excess coating, and other foreign matter. Flex rubber gasket and insert in the gasket recess of the bell socket. Apply a thin film of gasket lubricant supplied by pipe manufacturer, to either the gasket or the spigot end of the joining pipe.
     2. Start spigot end of pipe into socket with care. The joint shall then be completed by forcing the plain end to the bottom of the socket with a forked tool or jack type device. Field cut pipe shall have the end filed to match the manufactured spigot end.
     3. Permissible deflection in push-on joint pipe shall not be greater than 2/3 of that listed in AWWA C600.
     4. Install PVC pipe in accordance with ASTM D-2321 and manufacturer’s recommendations.
  2. **JOINING HDPE PIPE**
     1. Butt Fusion: The pipe shall be joined by the butt fusion procedure outlined in ASTM F 2620 or PPI TR-33. All fusion joints shall be made in compliance with the pipe or fitting manufacturer’s recommendations.
     2. Saddle fusion: Saddle fusion shall be done in accordance with ASTM F 2620 or PPI TR-41 or the fitting manufacturer’s recommendations and PPI TR-41.
     3. Socket Fusion: Molded socket fusion fittings are only to be used for joining of HDPE pipe from 1/2 inch to 2” in size. Socket fusion shall be done in accordance with ASTM F 2620 or the fitting manufacturer’s recommendations. Socket fusion is the process of fusing pipe to pipe, or pipe to fitting by the use of a male and female end that are heated simultaneously and pressed together so the outside wall of the male end is fused to the inside wall of the female end.
     4. Electrofusion: Electrofusion joining shall be done in accordance with the manufacturers recommended procedure. Other sources of electrofusion joining information are ASTM F 1290 and PPI TN 34. The process of electrofusion requires an electric source , a transformer, commonly called an electrofusion box that has wire leads, a method to read electronically (by laser) or otherwise input the barcode of the fitting, and a fitting that is compatible with the type of electrofusion box used.
  3. **SETTING VALVES AND VALVE BOXES**
     1. Install valves with operator stems in the vertical plane through the pipe axis and perpendicular to the pipe axis. Locate valves where shown on Contract Drawings. Thoroughly clean before installation. Check valves for satisfactory operation.
     2. Equip all underground valves with valve boxes where shown on the Contract Drawings. Set valve boxes in accordance with Standard Details. Set box in alignment with valve stem centered on valve nut. Set the valve box to prevent transmitting shock or stress to the valve. Set the box cover flush with the finished ground surface or pavement.
     3. Construct manholes for all underground valves where shown on the Contract Drawings. Construct manholes so as to prevent transmitting any load or shock to the valve or pipe. Locate manholes and valve relative to each other in order that packing, operator and other parts of the valve are readily accessible for minor repairs.
     4. Provide forcemain air combination valves at locations indicated on Drawings and at all high points of the forcemains. Install plug valve between main and air valves per Standard Details. Construct manholes for air valves per Standard Details.
     5. Use sleeves where pipes, valves stem extensions or equipment parts pass through concrete or masonry walls or slabs. Sleeves shall be either cast iron or schedule 40 steel of sufficient size to allow sealing around pipes and clearance for valve stems or equipment. Extend vertical sleeves through slabs 1 inch above top surface.
     6. Use cast iron sleeves with intermediate collars to anchor and provide a water stop on outside of sleeves that pass through exterior walls below grade. Pipes shall be sealed using Link-Seals or approved equal. Where Link-Seals become impractical, non-shrink grout may be considered on a case-by-case basis.
     7. Provide concrete thrust blocking and/or pipe restraints at all tees, bends, vertical offsets, or other locations noted on the Contract Drawings. Install thrust blocks per Standard Details. Install pipe restraints per distance given in Standard Details.
     8. Concrete reaction anchors shall bear against undisturbed earth and shall be of the size and shape shown in Standard Details.
     9. Restraints shall either be Meg-a-Lug or approved equal appropriate for the pipe material OR the pipe provided shall have integral restrained joints.
     10. Where retainer glands are used, extreme care shall be taken so that each set screw is tightened as recommended by the manufacturer before the pipe is backfilled and tested.
     11. Construct service connections for sewer main to property line as follows:
         1. Place a tee fitting or sewer tap with 4” outlet in the sewer where service connection is to be constructed. Lay 4” pipe from the tee/tap to the property line on a grade as shown on the Standard Details. Follow manufacture’s installation recommendations for sewer tee or sewer tap installation.
         2. Determine the depth of service connections by the deepest requirements shown on the Standard Details.
         3. Service lines that cross under concrete aprons, sidewalks, or other structures shall be constructed in their entirety of Class 51 ductile iron.
         4. Service lines that have less than 3.5 feet of cover in in public roads or right-of-way shall be constructed in their entirety of Class 51 ductile iron.
         5. Place a 2 in. x 4 in. solid piece of lumber or section of PVC pipe at the end of each service connection to act as a marker. The marker shall be set vertically and extend from invert to 6 in. above grade.
     12. Stream crossings shall adhere to the following:
         1. Watertight manhole covers shall be provided when the top of the manhole is below the 100-year flood/wave elevation.
         2. On buried lines, concrete encasement shall be provided around the sewer pipe at the crossing.
     13. Manholes shall be constructed to the elevations shown on the Contract Drawings in accordance with the provisions of the Standard Details as follows:
         1. Set manhole base section on bed of VDOT #57 stone to a minimum depth of 6 in. Stone shall be thoroughly compacted and carefully leveled.
         2. Join all manhole riser and cone or flat slab top sections by the use of bitumastic rope type sealant. Use of O-ring rubber gaskets is not allowed.
         3. Pack and brush joints in FRP lining in acid-resistant manholes with sealant to provide a watertight and acid-resistant seal. Field weld joints in PVC lining of acid-resistant manholes in accordance with manufacturer's instructions.
         4. Install pipe stubs in manholes where called for on the Contract Drawings. All stubs shall extend 12" - 18" beyond the manhole and shall be sealed watertight with a plug or cap.
         5. Install flexible manhole connections for all pipe connections and apply sealant to completely fill joint between manhole barrel and flexible connection for the full thickness of the manhole barrel.
         6. Plug lift holes and repair any defects in manhole.
         7. Set and seal adjusting rings per grade requirements and manufacturer’s recommendations.
         8. Bolt manhole frames to manhole cone or flat slab top section as shown on the Standard Details.
         9. Construct drop connections where called for on the Contract Drawings per Standard Details.
     14. Construct benches as follows:
         1. Construct of concrete per Standard Details.
         2. Construct channel with smooth semicircular bottoms matching inside diameters of the connecting sewers. Change direction of flow with a smooth curve of as large a radius as the manhole size will permit. Change size and grade of channels gradually and evenly. Channels may be formed either:
            1. Directly in the concrete manhole bottom;
            2. Made of channel pipe laid in concrete, or;
            3. Laying a full section of sewer pipe through the manhole and cutting out the top half once concrete has hardened (this is only for straight-through manholes).
         3. Slope benches between 2 and 4 inches per foot toward channel for drainage.
         4. Lowest elevation of bench shall be at the spring line of the outgoing pipe.
         5. Where stubs or knockouts are provided for future pipe connections, bench shall be so formed.
         6. Use sulfate resistant cement for concrete or mortar on all acid-resistant manholes.
         7. Where sealant is used, bench shall not be in contact with pipe or flexible pipe connection.
  4. **PIPE DETECTION MATERIALS**
     1. Install marking tape in all trenches containing buried, non-metallic, pressure pipe lines and on all gravity sewer laterals. Tape shall be installed in all trenches a minimum of 18” over the pipe. Place tape on edge of trench toward the center of the pavement in roadways. In other locations, place tape to the north or east of the utility line. Wrap tape around all valves. Tape shall be made electrically conductive throughout the entire system through the use of splices of a type recommended by the manufacturer.
     2. In addition to the marking tape, a tracing wire of 12 gauge copper shall be installed and taped directly on the pipe in a manner that a continuous tract results. Provide wire turnup boxes every 2,000 LF if no other appurtenances (valves, air releases) are available within that distance.
     3. Marker balls or discs shall also be installed at locations and depth per Standard Details.
  5. **SEPTIC TANK ABANDONMENT**
     1. Where called for in the Contract Documents, all existing homes with septic system shall have such systems properly abandoned. The method for abandonment shall be as follows:
        1. House shall be connected to the public sewer prior to septic system abandonment.
        2. Septic tank shall be pumped to empty by a licensed septic tank contractor. Receipts must be provided to the Engineer or PSA’s representative.
        3. Tank lid shall be broken. The broken lid may be deposited into the tank.
        4. Tank shall be filled with sand or #57 stone.
        5. Backfill from top of tank to grade with native material.
        6. Compact backfill using suitable equipment.
        7. Topsoil and seed area per Grading & Seeding specifications.
     2. Alternate systems may require additional work, including disconnection and removal of pumps. Where such systems are known, they shall be indicated on the Contract Documents. The Contractor is responsible for accounting for any additional costs for such systems in his bid price. No additional allowance shall be made for the presence of such systems where they are noted in the Contract Documents.
  6. **TESTING GRAVITY SEWER LINES AND MANHOLES**
     1. Testing of gravity sewer lines shall be conducted between manholes. Provide all labor, materials, tools, and equipment necessary to make the tests. All equipment and methods used shall be acceptable to the PSA. All monitoring gages shall be subject to calibration, if deemed necessary.
     2. Sanitary sewer lines shall be tested after backfill using a low-pressure air test in accordance with ASTM C924.
     3. Low-pressure air test
        1. Summary of Method: Plug the section of the sewer line to be tested. Introduce low-pressure air into the plugged line. Use the quantity and rate of air loss to determine the acceptability of the section being tested.
        2. Preparation of the sewer line: Flush and clean the sewer line prior to testing, thus serving to wet the pipe surface as well as clean out any debris. A wetted interior pipe surface will produce more consistent results. Plug all pipe outlets using approved pneumatic plugs with a sealing length equal to or greater than the diameter of the line being tested to resist the test pressure. Give special attention to laterals.
        3. Ground Water Determination: Install a 1/2 inch capped galvanized pipe nipple, approximately 12 inches long, through the manhole on top of the lowest sewer line in the manhole. Immediately prior to the line acceptance test, the ground water elevation shall be determined by removing the pipe cap and blowing air through the pipe nipple into the ground so as to clear it, and then connecting a clear plastic hose to the pipe nipple. The hose shall be held vertically and a measurement of the height in feet of water over the invert of the pipe shall be taken after the water has stopped rising in the plastic hose.
        4. Procedures: Determine the test duration for the section under test by computation from the applicable formulas shown in ASTM C828. The pressure-holding time is based on an average holding pressure of 3 psi gage or a drop from 3.5 psi to 2.5 psi gage.
        5. The test shall be conducted between two consecutive manholes. The test section of the sewer shall be plugged at each end, with one plug tapped for pressurizing the line with an air compressor.
        6. All service laterals, stubs, and fittings into the sewer test section shall be properly plugged and carefully braced against the internal pressure to prevent air leakage by slippage and blowouts.
        7. Connect air hose to tapped plug selected for the air inlet, then connect the other end of the air hose to the portable air control equipment. The air control equipment shall include a shutoff valve, pressure regulating valve, pressure reduction valve, and a monitoring pressure gauge having a pressure range from 0 to 10 psi. The gauge shall have divisions of 0.1 psi at a minimum and shall be accurate to 0.04 psi +/-. Connect another air hose between the source of compressed air and the air control equipment.
        8. Add air slowly until the internal air pressure of the sewer line is raised to approximately 4.0 psi gage. After an internal pressure of approximately 4.0 psig is obtained, throttle the air supply to maintain the pressure above 3.5 psi for at least five minutes to permit the temperature of the entering air to equalize with the temperature of the pipe wall. During this time, check all plugged fittings with a soap solution to detect any leakage at connections. If any leakage is detected, release air pressure, tighten all leaks, and start test again.
        9. Once the stabilization period is over, shut off air supply. Before starting the test, the pressure may be allowed to drop to 3.5 psig. Record the drop in pressure for the test period. If the pressure has dropped more than 1.0 psi gage during the test period, the line shall be presumed to have failed. The test may be discontinued when the prescribed test time has been completed even though the 1.0 psig drop has not occurred.
        10. The test procedure may be used as a presumptive test which enables the installer to determine the probable acceptability of the line prior to backfill and subsequent construction activities.
        11. If the pipe to be tested is submerged in ground water, the test pressure shall be increased 1.0 psi for every 2.31 feet the ground water level is above the invert of the sewer.
        12. Air test tables are provided in the Standard Details.
        13. Safety: The air test may be dangerous if, because of lack of understanding or carelessness, a line is improperly prepared.
        14. It is extremely important that the various plugs be installed and braced in such a way as to prevent blowouts. In as much as a force of 250 lb. is exerted on an 8 inch plug by an internal pipe pressure of 5 psi, it should be realized that sudden expulsion of a poorly installed plug or of a plug that is partially deflated before the pipe pressure is released can be dangerous.
        15. As a safety precaution, pressurized equipment shall include a regulator or relief valve set at perhaps 10 psi to avoid over-pressurizing and damaging an otherwise acceptable line. No one shall be allowed in the manholes during testing.
     4. Vacuum testing of manholes:
        1. A table for vacuum testing is provided in the Standard Details.
        2. Vacuum tests shall be conducted on newly constructed manholes following construction & after all connections have been made but before any backfilling around the manhole. Successful testing shall be accomplished before any backfilling operations. All manholes shall be free of standing water prior to conducting the vacuum test.
        3. Provide necessary vacuum pump, pneumatic plugs and accessories required for proper performance of the test. Plugs shall have a sealing strength equal to or greater than the diameter of the connecting pipe to be sealed.
        4. Follow all local, state and federal safety precautions. Brace inverts if lines entering the manhole have not been backfilled or otherwise restrained to prevent pipe from being dislodged and pulled into the manhole. All stubouts, manhole boots, and pipe plugs shall be secured to prevent movement while the vacuum is drawn.
        5. Install vacuum tester head assembly at the top access of the manhole. Adjust the cross brace to insure that the inflatable sealing element inflates and seals against the straight top section of the manhole if possible.
        6. Attach the vacuum pump assembly to the proper connection on the test head assembly. Make sure the vacuum inlet/outlet valve is in the closed position.
        7. Following safety precautions and testing equipment manufacturer's instructions, inflate sealing element to the recommended maximum inflation pressure. Do not overinflate.
        8. Start the vacuum pump assembly engine and allow preset pump to stabilize. Open the inlet/outlet ball valve and evacuate the manhole to 10" Hg.
        9. Close vacuum inlet/outlet ball valve and monitor vacuum for specified test period (see table). If vacuum does not drop in excess of 1" Hg., manhole is considered acceptable and the manhole passes the test. If manhole fails the test, complete necessary repairs and repeat test procedures until satisfactory results are obtained.
        10. If the manhole fails the test, necessary repairs shall be made or the manhole shall be replaced and the test repeated until the manhole passes the test.
        11. If the mastic from any manhole section joint is pulled out during the test, the manhole shall be disassembled and the mastic replaced.
        12. Testing apparatus shall be equal to “Manhole Vacuum Tester” as manufactured by P.A. Glazier, Inc., of Worcester, MA.
        13. Deflection and Grade testing of flexible pipe gravity sewer
        14. Conduct deflection tests on all flexible pipe gravity sewer lines in order to verify the roundness and proper installation of the pipelines.
     5. Mandrel Deflection Testing
        1. When tests are conducted within 30 days after backfilling has been completed and compacted, the pipe must retain 95% of design diameter. When tests are conducted more than 30 days after backfilling has been completed and compacted, the pipe must retain 92.5% of design diameter. Mandrel diameter shall be in accordance with ANSI/ASTM D- 3034 & F-679. Mandrels shall be inspected by the PSA with proving rings prior to use and shall meet the following requirements:
           1. Mandrel Sizing shall be the base pipeline diameter times the percent of deflection limit.
           2. The mandrel shall be of open design to prevent debris build-up from occurring between the channels of adjacent fins which in-turn causes erratic test results. The fin sets shall number at least nine (9) and shall be removable from the mandrel core by unscrewing the wing-nut and loosening the end caps which secure the fins in position. The contact area of the fins shall be equal to the nominal inside diameter of the pipe. Gauges of various diameters shall be assembled by substituting fin sets of appropriate dimension.
        2. After the pipeline has been installed and backfill materials have been compacted to their required standard densities, as set out in ASTM D 2321 or other applicable standard, the mandrel shall be pulled by hand through the pipeline with a suitable rope or cable that is connected to an eye-bolt at one end of the gauge. A similar rope or cable shall be attached to the eye-bolt at the opposite end of the mandrel and tension shall be applied to it to insure that the mandrel maintains its correct position during testing and also to remove the mandrel if it should become lodged in an excessively deflected pipeline. Winching or other means of forcing the mandrel through the pipeline are unacceptable.
        3. If any section does not allow the mandrel to pass, then that entire section of pipe shall be removed and replaced.
     6. Lamp Grade Testing
        1. In addition to mandrel testing, a lamp test shall be performed. A lamp shall be pointed up/down the line toward the next manhole. The lamp shall have sufficient candlepower to be seen at the other end of the line. A mirror shall be placed at the receiving end. The light shall be moved in such a way as to allow complete observation of the line interior in the mirror.
        2. If any upward or downward deflection of the pipe is visible, then that entire section of pipe shall be removed and replaced at the correct grade.
        3. The test shall be repeated on the replaced section.
        4. A permanent record of all testing with locations where repair and/or replacement was required shall be kept by the Contractor and forwarded to the PSA after completion of testing and acceptance of each line.
        5. All materials and labor required for testing and replacement of pipelines shall be furnished by the Contractor and the cost thereof included in the price bid for furnishing and installing pipelines.
  7. **ACCEPTANCE TESTS – PVC & DI SEWER FORCEMAINS**
     1. Supply the pumps, calibrated gages and meters, and all the necessary apparatus. Notify the PSA at least 72 hours in advance of the test date and perform tests in presence of the PSA’s representative.
     2. The PSA will supply potable water (if available) at no cost for one test of forcemain lines only; any additional water will be paid for by the Contractor.
     3. If using PSA supplied potable water and assuming no sewer has passed through the forcemain, contractor shall utilize the Flushing Mechanism detail provided in the Standard Details when filling waterlines. If the forcemain has been in contact with sewer prior to testing then the contractor must fill the line from the sewer pump station using water from the wetwell or another pump with a supply not directly connected to the potable water system.
     4. After the line has been backfilled and at least seven days after the last concrete reaction anchor has been poured, subject the line or any valved section of the line to a hydrostatic pressure test in accordance with AWWA C600, except as modified herein. Fill the system with water at a velocity of approximately 1 foot per second while necessary measures are taken to eliminate all air. After the system has been filled, raise the pressure by pump to 1.5 x the working pressure or 150 psi, whichever is greater. Test pressures shall:
        1. Not be less than 1.25 x the working pressure at the highest point along the test section,
        2. Not exceed thrust restraint pressure,
        3. Not vary by more than +/- 5 psi, and,
        4. Not exceed twice the rated pressure of the valves when test includes closed plug valves.
     5. Measure pressure at the low point on the system compensating for gage elevation. Maintain this pressure for two hours. If pressure cannot be maintained, determine cause, repair and repeat the test until successful.
     6. A leakage test shall be conducted concurrently with the pressure test in accordance with AWWA C600, except as modified herein. Leakage shall be determined with a calibrated test meter, furnished by the Contractor. Leakage is defined as the quantity of water required to maintain a pressure within 5 psi of the specified test pressure, after air has been expelled and the pipe filled with water. Leakage shall not exceed that provided on the table in the Standard Details. If leakage exceeds that specified, find and repair the leaks and repeat the test until successful.
     7. All visible leaks shall be repaired regardless of the amount of leakage.
  8. **ACCEPTANCE TESTS – HDPE PIPELINES**
     1. Supply the pumps, calibrated gages and meters, and all the necessary apparatus. Notify the PSA at least 72 hours in advance of the test date and perform tests in presence of the PSA’s representative.
     2. The PSA will supply potable water (if available) at no cost for one test of forcemain lines only; any additional water will be paid for by the Contractor.
     3. Pressure and leak tests of HDPE water system shall be conducted in accordance with ASTM F2164.
     4. The pipeline shall be slowly filled with potable water and all trapped air bled off. The main shall undergo a hydrostatic pressure test using pressure at the lowest elevation in the system at 150 psi or 1.5x working pressure, whichever is greater, but no greater than the pipe design pressure.
     5. The pressure shall be maintained constant for 4-hour period by adding makeup water. After 4-hour period is completed, the pressure shall remain steady at the system low point within 5% of the target test pressure for one hour.
     6. The total test time shall not exceed 8 hours. If the pipeline has to be retested, the pipe must be depressurized and allowed to “relax” for at least 8 hours before the next testing sequence.
     7. No visible leakage shall be present. If leakage is observed at a fusion joint, complete rupture may be imminent. The Contractor shall move all personnel away from the joint and depressurize the main. Leaks, failure, or defective construction shall be promptly repaired by the Contractor at the Contractor’s sole expense.
     8. For safety reasons, pneumatic (compressed air) leakage testing of HDPE pressure piping is prohibited.
  9. **GRAVITY SEWER TELEVISION INSPECTION**
     1. All gravity sewer mains installed shall be inspected by this method in addition to other inspection and testing methods provided for in these specifications.
     2. The work covered by this section consists of providing all labor, equipment, material and supplies and performing all operations required to conduct the internal closed-circuit television inspection of all designated sewer lines. The Contractor shall be responsible for removing his equipment from the sewers and for all associated sewer and restoration repairs necessary as a result of his work.
     3. Definitions:
        1. Pre-Installation TV Inspection: Pre-installation TV is a video inspection by the Contractor of sewer lines specified for rehabilitation to confirm cleaning, location of service connections, and constructability of line rehabilitation in accordance with the contract documents.
        2. Post-Installation TV Inspection: Post-installation TV is a video inspection to determine that rehabilitation and/or replacement of sanitary sewers has been completed in accordance with the contract documents.
        3. TV Inspection Log: Information collected and recorded by each TV operator for any TV inspection effort and shall include all pertinent information for the respective inspection section.
        4. PACP: Pipeline Assessment and Certification Program. A voluntary CCTV Inspection Standardization certification and observation coding system sponsored by the National Association of Sewer Service Companies (NASSCO).
        5. Submittals: Submittals shall be made by the Contractor in accordance with the procedures set forth in the General Conditions, Supplemental Conditions, and Section 01000 - General Requirements, and as described below.
        6. Compact Disc (CD), or Digital Video Disc (DVD). The storage media shall be specified by the PSA.
        7. TV Inspection Log: Each TV Inspection Log shall be submitted to the PSA accompanied by the respective video tape.
        8. PACP Operator Certification: Prior to initiating CCTV inspection work associated with condition assessment assignments, the Contractor shall present the PSA with copies of PACP certifications of operators that will be performing the work.
  10. **EXECUTION**
      1. The designated sewer pipe sections shall be televised in accordance with the Contract Documents.
  11. **EQUIPMENT**
      1. Select and use closed-circuit television equipment that will produce a color DVD, or MP4 digital file.
      2. Pipe Inspection Camera - Produce a video using a pan-and-tilt, radial viewing, pipe inspection camera that pans ± 275 degrees and rotates 360 degrees. The television camera used for the inspection shall be specifically designed and constructed for such inspection. The camera shall be operative in 100% humidity conditions. Use a camera with an accurate footage counter that displays on the monitor the exact distance of the camera (to the nearest tenth of a foot) from the centerline of the starting manhole. 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. Lighting for the camera shall be suitable to allow a clear picture of the entire periphery of the pipe. A reflector in front of the camera may be required to enhance lighting in dark or large diameter pipe. The video camera shall be capable of showing on the digital inspection the PSA's name, Project name, Contractor name, date, line size and material, line identification (PSA’s manhole numbers at both ends) and ongoing footage counter. The camera, television monitor, and other components of the video system shall be capable of producing picture quality to the satisfaction of the PSA; and if unsatisfactory, equipment shall be removed and replaced with adequate equipment. No payment will be made for an unsatisfactory inspection.
  12. **FLOW CONTROL**
      1. Perform Bypass Pumping when necessary.
      2. If during TV inspection of a sewer section, the wastewater flow depth exceeds 20 percent of the inside pipe diameter, reduce the flow depth to an acceptable level by performing the TV inspection during minimum flow hours, bypass pumping, plugging or by pulling the camera with swab, high-velocity jet nozzle or other acceptable dewatering device. Video inspections performed while floating the camera is not acceptable unless approved by the PSA.
  13. **DOCUMENTATION OF TELEVISION INSPECTION**
      1. All Television Inspections shall be documented using a datalogger and reporting system as approved by the PSA. If a PACP compliant inspection is required, then a PACP compliant datalogger and coding system must be used to perform the work.
      2. Television Inspection Logs: Computer printed location records shall be kept by the Contractor and shall clearly show the location and orientation in relation to an adjacent manhole of each infiltration point observed during inspection. In addition, other points of significance such as locations and orientations of service connections, building sewers, unusual conditions, roots, storm sewer cross connections, broken pipe, presence of scale and corrosion, and other discernible features shall be recorded and a copy of such records shall be supplied to the PSA.
      3. Digital Photographs: Noted defects and lateral connections shall be documented as color digital files and color hard copy print-outs. Photo logs shall accompany each photo submitted.
      4. Video Recordings: The purpose of video recording shall be to supply a visual and audio record of problem areas of the lines that may be replayed. Video recordings shall include an audio track recorded by the inspection technician during the actual inspection work describing the parameters of the line being inspected (i.e. location, depth, diameter, pipe material), as well as describing connections, defects and unusual conditions observed during the inspection. Video recording playback shall be at the same speed that it was recorded. Slow motion or stop-motion playback features may be supplied at the option of the Contractor. Once inspected, the CDs/DVDs shall be labeled and become the property of the PSA. The Contractor shall have all video and necessary playback equipment readily accessible for review by the PSA during the project.
  14. **PRE-INSTALLATION INSPECTION FOR SEWER LINES TO BE REHABILITATED**
      1. 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 or point repair only.
      2. The camera shall be moved through the line in either direction at a moderate rate, stopping when necessary to permit proper documentation of the sewer’s condition. In no case will the television camera be pulled at a speed greater than 30 feet per minute. Manual winches, power winches, TV cable, and powered rewinds or other devices that do not obstruct the camera view or interfere with proper documentation of the sewer conditions shall be used to move the camera through the sewer line.
      3. If, during the inspection operation, the television camera will not pass through the entire pipe section due to blockage or pipe defect, the Contractor shall set up his equipment so that the inspection can be performed from the opposite manhole. If, again, the camera fails to pass through the entire pipe section, the inspection shall be considered complete and no additional inspection will be required at that time. Improper cleaning will not be a reason for incomplete televising of a line section.
      4. When manually operated winches are used to pull the television camera through the line, hand operated radios, telephones, or other suitable means of communication shall be set up between the two manholes of the section being inspected to insure good communication between members of the crew.
      5. During the internal inspection, the television camera shall be temporarily stopped at each defect along the line. The nature, location, and orientation of the defect shall be recorded by the Contractor. Where defects are also active infiltration sources, the rate of infiltration in gallons per minute shall be estimated by the Contractor and recorded. The camera shall also be stopped at all service connections and identified by footage and clock orientation.
      6. The camera operator shall slowly pan and tilt at beginning and ending manhole connections, each service connection, joints, visible defects, and at pipe material transitions.
      7. TV inspections shall be continuous for pipe segments between manholes. Do not show a single segment on more than one CD/DVD, unless specifically approved by the PSA.
  15. **POST - INSTALLATION INSPECTION**
      1. Post-installation TV inspection shall not be completed until all work, including main line and manhole visual, pressure testing, deflection and leakage testing is complete on a section of line.
      2. Post-installation TV inspection shall be completed by the Contractor in the presence of the PSA representative.
      3. The post-installation TV inspection shall be completed to confirm that rehabilitated lines are free of defects. Provide a color video showing the completed work. Prepare and submit Television Inspection Logs providing location of service connections along with location of any discrepancies. Manhole work, including benches, inverts and pipe penetrations into manhole, should be complete prior to post-installation TV work.
      4. For post-installation TV inspection, exercise the full capabilities of the camera equipment to document the completion and the conformance of the work to the Contract Documents. Provide a full 360-degree view of pipe, joints and service connections.
      5. The camera shall be moved through the line in either direction at a moderate rate, stopping when necessary to permit proper documentation of the sewer’s condition. In no case will the television camera be pulled at a speed greater than 30 feet per minute. Manual winches, power winches, TV cable, and powered rewinds or other devices that do not obstruct the camera view or interfere with proper documentation of the sewer conditions shall be used to move the camera through the sewer line.
      6. When manually operated 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 inspected to insure good communication between members of the crew.
      7. The importance of accurate distance measurements is emphasized. The meter device shall be accurate to one tenth of a foot.
      8. TV inspections shall be continuous for pipe segments between manholes. Do not show a single segment on more than one CD/DVD, unless specifically allowed by the PSA.
      9. Prior to inserting the television camera into the pipeline, the Contractor shall flush and clean the pipeline with clear, potable water into the terminal upstream manhole or last access structure on any given gravity sewer branch of the pipeline to be inspected with a television camera. The Contractor is responsible for acquiring, collecting and disposing of the water, at no cost to the PSA.
  16. **ACCEPTANCE OF TELEVISION INSPECTION RESULTS**
      + 1. Television inspection results will be accepted by the PSA when the video and inspection logs meet the requirements of this specification section.

END OF SECTION