



SPECIFICATION 333001: GRAVITY WASTEWATER SEWERS AND APPURTENANCES

PART 1.0 GENERAL

1.1 DESCRIPTION

- 1.1.1 The following specification covers the design, installation, inspection, testing, and acceptance of gravity wastewater systems. Construction consists of furnishing all labor, equipment, tools, appliances and materials for performing all operations necessary for the construction and installation of gravity wastewater sewers and service lines, including all manholes, casings, and appurtenances, complete and ready for operation as shown on the construction drawings and described herein. All requirements of the Florida Department of Environmental Protection shall be complied with in addition to the criteria contained within.
- 1.1.2 The Developer/Contractor shall furnish to the County a two year warranty on the materials, fabrication, and workmanship of any and all polyvinyl chloride pipe and fittings furnished and installed. Warranty period shall commence upon written acceptance of particular component or appurtenance by County for ownership and operation.
- 1.1.3 All Construction plans, project submittals and record drawings shall comply with the requirements of Section 1 and Section 2 of the Hillsborough County Public Utilities Department (PUD) Technical Manual.

1.2 REFERENCE DOCUMENTS

- American Association of State Highway & Transportation Officials (AASHTO)
- American Concrete Institute (ACI)
- American National Standard Institute (ANSI)
- American Society of Mechanical Engineers (ASME)
- American Society of Sanitary Engineers (ASSE)
- American Society for Testing and Materials (ASTM)
- American Water Works Association (AWWA)
- Florida Department of Transportation (FDOT)
- Portland Cement Association (PCA)
- Uni-Bell Plastic Pipe Association

1.3 SHOP DRAWINGS AND SUBMITTALS

- 1.3.1 For County projects, shop drawings and related manufacturer's product certifications shall be made in accordance with the General and Special Conditions of the Contract for approval prior to purchase or fabrication of the material by the manufacturer. The following items require Shop Drawings. This list may not include all items for which shop drawing submittals are required to meet the requirements of the project:
 - 1.3.1.1 Detail Drawings of all classes of pipe, joints and fittings.
 - 1.3.1.2 Pipeline laying schedule tabulated and referenced to construction line and grade controls shown on plans, with station, offset, and elevations. References shall be provided for pipe fittings and other important features of the pipeline.
 - 1.3.1.3 Service Connections.



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- 1.3.1.4 Manholes.
 - 1.3.1.5 Manhole frames and covers.
 - 1.3.1.6 All appurtenant items.
 - 1.3.1.7 Contractor's cleaning and testing plans for all gravity system piping and manholes.
- 1.3.2 Certification and test reports for the materials, manufacturing, and testing of the types of pipe supplied shall be performed and furnished by the pipe manufacturer in accordance with the latest standards of the industry as described in Part 1.2 herein.
- 1.3.3 **Shop drawing submittals for items listed in Appendix B, the Approved Products List, do not require material certification.**
- 1.3.4 Submit a copy of any design exception prior to installation. Design exceptions are issued by the Utility Design Section Manager. Any deviation from the specifications requires a design exception.
- 1.4 RELATED WORK**
- All Specifications of Division 03
 - All Specifications of Division 33
 - Hillsborough County Public Utilities Department (PUD) Technical Manual
 - Hillsborough County Utility Accommodation Guide

PART 2.0 DESIGN

2.1 FLOW CRITERIA

- 2.1.1 Flow estimates for design shall be calculated based on full or projected ultimate development. The average daily flow (ADF) for single family or master-metered residences shall be the per unit demand factors contained in the most current Hillsborough County Utility Rate Resolution. Industrial and commercial design flows for sanitary wastewater shall be in accordance with Table 1 of the County's Utility Rate Resolution.
- 2.1.2 Wastewater gravity collection systems, pumping stations, and force mains shall be designed for average daily flow times the appropriate peaking factor. Refer to Section 4 of the PUD Technical Manual for flow criteria and peaking factors.

2.2 MINIMUM LINE SIZE

- 2.2.1 Gravity Mains: Gravity mains shall be sized to accommodate peak flow (ref. Part 2.1) when flowing 1/2 full. No gravity sewer main shall be less than eight inches in diameter.
- 2.2.2 Laterals: Minimum diameter shall be four inches for residential service, and six inches for commercial service.

2.3 ALIGNMENT

- 2.3.1 All gravity mains shall be laid with straight alignment between manholes.
- 2.3.2 Wastewater collection systems are to be constructed within County right-of-way.

2.4 DEPTH OF COVER



- 2.4.1 The depth of cover over all mains, within County right-of-way or easement, shall be not less than 48 inches (except for laterals).
- 2.4.2 The depth of the lateral at the property line (measured from the crown of pipe) shall be no less than 36 inches and no greater than 48 inches below design grade.

2.5 SLOPE

- 2.5.1 Gravity mains shall be designed with the following minimum grades:

Gravity Main	Minimum Grade
8"	0.40%
10"	0.28%
12"	0.22%

- 2.5.2 Mains with diameters greater than 12 inches shall be designed to have mean velocities when flowing half full of not less than 2.0 feet per second. For velocity determinations, Manning's Formula "N" value shall be 0.013 for PVC pipe.

2.6 HORIZONTAL SEPARATION

- 2.6.1 Wastewater gravity sewers shall be laid at least 10 feet horizontally from any existing or proposed potable water main.
- 2.6.2 A three foot horizontal separation shall be maintained between a wastewater gravity/force main and all other pipelines. The distance shall be measured face to face.
- 2.6.3 In cases where it is not practical to maintain the specified separation a design exception must be obtained from Utility Design Section Manager prior to construction.

2.7 CROSSINGS

- 2.7.1 Vertical separation between wastewater gravity sewers crossing potable water mains, and other pipelines/utility lines shall be a minimum vertical distance of 18 inches between the outside of the other utility line(s) and the outside of the gravity sewers. This shall be the case where the other pipeline is either above or below the gravity sewer.
- 2.7.2 Potable water main crossings below the gravity sewer should be avoided whenever possible. If the potable water main must cross under a gravity sewer, the crossing shall have a vertical clearance of 18 inches (min.), and be arranged so that the gravity sewer joints will be equidistant and as far as possible from the potable water main joints.
- 2.7.3 See Specification 333006, Exhibits S-1A and S-1B for details on intersecting gravity and storm mains.
- 2.7.4 If the above vertical separation is not possible, a design exception must be obtained from the Utility Design Section Manager prior to construction.

2.8 GRAVITY LATERALS



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- 2.8.1 Each lateral shall be supplied with a WYE fitting and 1/8 bend at the main and laid at a minimum slope of 1/8-inch per foot to one foot past the right-of-way line, where a clean out will be installed in accordance with Specification 333006, Exhibits S-2A and S-2B.
- 2.8.2 Residential double services are allowed, but the lateral size must be six inches.
- 2.8.3 Laterals shall be straight from the clean-out to the WYE fitting at the main, or the connection at a terminal manhole.
- 2.8.4 Laterals that connect into terminal manholes shall be considered a “secondary” line, and shall be designed as such. See Specification 333006 Exhibit S-3B.
- 2.8.5 Laterals shall be marked in the field per Part 4.9.

2.9 WASTEWATER MANHOLES

- 2.9.1 Manholes shall be installed at the end of each line, at all changes in grade, size or alignment, and at all gravity main collection intersections.
 - 2.9.1.1 The distance between manholes shall not be greater than 400 feet, unless prior approval is obtained from the County.
 - 2.9.1.2 Cleanouts may be used only for special conditions and shall not be substituted for manholes.
- 2.9.2 Manholes shall be minimum 48 inches inside diameter where incoming lines are 16 inches or less in diameter, or 60 inches minimum inside diameter where incoming lines are larger than 16 inches diameter or depth of manhole exceeds 15 feet. A minimum access diameter of 24 inches shall be provided.
- 2.9.3 The minimum manhole depth is five feet from the top of the manhole cover to the bottom invert.
- 2.9.4 Materials of construction and installation shall be in accordance with the applicable provisions of Part 3 and 4, and Specification 333006, Exhibits S-3A through S-3D and Exhibit S-4.
- 2.9.5 Manholes shall consist of a base with a monolithically cast bottom barrel section, vertical pipe barrel sections, concentric top section, adjustment section or grade ring(s), and a frame and cover.
- 2.9.6 The manhole adjustment section (grade rings) shall be a minimum of three inches and shall not exceed 18 inches in height. The adjustment section for new construction shall not exceed 12 inches in height.
- 2.9.7 All manholes shall be concentric in design. Eccentric manholes are not allowed.
- 2.9.8 Minimum wall thickness shall be five inches.
- 2.9.9 All manholes shall have a manhole lid insert installed (water infiltration “dish”).
- 2.9.10 A drop manhole connection shall be provided for any gravity mains entering at a vertical distance of 2.0 feet or more above the outgoing channel invert.
 - 2.9.10.1 In cases where the vertical distance is less than two feet, a drop pipe is not required, but a channel shall be constructed to guide the flow into the outgoing channel.
 - 2.9.10.2 The bottom drop section shall be monolithically cast with the bottom manhole section.



2.9.10.3 See Specification 333006, Exhibits S-4.

2.10 MANHOLE FRAMES AND COVERS

- 2.10.1 Manhole frames and covers, for structures and for manholes, shall be heavy duty frames and covers designed for traffic loads. Frames embedded in top slabs of structures or frames for structures with riser stacks shall be pressure-tight base flange type. The minimum inside access diameter shall be 24 inches.
- 2.10.2 Manhole frame and cover shall be designed to withstand an HS20-44 loading defined in the AASHTO Specifications.

2.11 WATERPROOF AND PROTECTIVE COATINGS

Protective coating(s) shall be applied to all interior surfaces of manholes when specified by Hillsborough County PUD.

PART 3.0 PRODUCTS

3.1 MATERIAL

3.1.1 Wastewater Gravity Pipe and Fittings: The following table lists the allowable pipe and fitting material for the various size wastewater gravity mains and laterals:

Diameter	Material	General Specifications
4" to 15"	PVC	ASTM D3034, SDR 26
8" to 12"	PVC	C900, DR 25
16" and greater	PVC	C905, DR 25

- 3.1.2 All pipe, fittings and appurtenances shall be supplied in accordance with the approved material list in Appendix B.
- 3.1.3 Alternative materials may be considered by Hillsborough County if proper testing documentation, performed by recognized industry authorities, is submitted for review to the PUD Product Review Committee prior to commencement of design. Refer to Section 1 of the PUD Technical Manual for submittal procedures. Tests on alternative materials should be at least as rigorous as testing conducted by ASTM, AWWA and ANSI. A letter of variance must be issued by PUD prior to commencement of installation of any alternative material.

3.2 PVC PIPE AND FITTINGS

- 3.2.1 PVC pipe and fittings, including laterals, shall be made of PVC material having a cell classification of 12454 B, 12454 C or 13354 B as defined in ASTM D1784. SDR 26 PVC pipe and fittings shall be used in the gravity sewer system and shall meet requirements of ASTM D3034. Gravity lines 16-inch and greater shall meet the requirements of ANSI/AWWA C905, SDR 25. The last run of PVC gravity line from the receiving manhole to the pump station shall be C900 or C905, DR 25.
- 3.2.2 Provisions must be made for contraction and expansion at each joint with an elastomeric gasket.
- 3.2.3 The bell shall consist of an integral wall section with solid cross-section elastomeric gasket ring, factory assembled and securely locked in place to prevent displacement and meeting requirements



of ASTM D3212.

- 3.2.4 Gaskets: All pipe gaskets shall conform to AWWA C111, and be made of Viton, EPDM, or SBR depending upon the service/soil conditions.
- 3.2.5 Standard minimum laying lengths shall be 20.0 feet one inch. Pipe shall be tested in accordance with ASTM D3212.
- 3.2.6 Each length of PVC pipe shall be marked with the following information: size, manufacturer, PVC sewer pipe, ASTM designation, manufacturer's code, and cell classification that will remain legible during normal handling, storage, and installation. Pipe color shall be green for wastewater mains.
- 3.2.7 Where PVC enters a manhole, a suitable manhole coupling or flexible manhole connector designed to produce a positive watertight connection shall be installed in the wall section of the manhole.

3.3 MANHOLES

- 3.3.1 Manhole base, barrel sections, and concentric top section shall conform to the design requirements of ASTM C478, "Specification for Pre-cast Reinforced Concrete Manhole Sections", except as modified herein. Steps and ladders shall not be installed. See Specification 333006, Exhibits S-3A through S-3D for details for standard manholes.
- 3.3.2 Cement shall meet the requirements of ASTM C150, Specification for Portland cement, Type II.
- 3.3.3 Vertical barrel sections shall be custom-made with openings to meet indicated pipe alignment conditions and invert elevations.
- 3.3.4 The base of the manhole shall be cast monolithically with the bottom manhole section.
- 3.3.5 Joint contact surfaces shall be formed with mechanical castings; they shall be parallel with two degrees slope, single offset, and nominal 1/16 inch clearance. Gaskets shall conform to ASTM C-443, "Joints for Circular Concrete Sewer and Culvert Pipe Using Rubber Gasket."
 - 3.3.5.1 Joint contact surfaces shall be sealed using a rubber gasket per the manufacturer's recommendations. Butyl and mastic sealants are not acceptable.
 - 3.3.5.2 An alternate joint contact seal may be used when the joint surface is manufactured with the tongue equipped with a proper recess (confined groove) for the installation of an "O"-ring, conforming to ASTM C443.
- 3.3.6 Flexible manhole connector material shall be used to join pipes to manhole barrel and shall consist of an elastomeric connector compound meeting the requirements of ASTM C923 "Resilient Connectors between Concrete Manhole Structures and Pipes."
 - 3.3.6.1 For new manholes the connectors shall be integrally cast into the manhole.
 - 3.3.6.2 Connector components for connections into manholes shall be flexible connectors meeting the requirements of ASTM C923. This includes flexible connectors for laterals entering the manhole.
- 3.3.7 The interior of the adjustment section (ie. grade rings) shall be coated with an acid resistant coating as specified in Appendix B when grade rings are concrete. Grade rings shall be concrete or HDPE.
- 3.3.8 Manhole lid inserts shall comply with the following:
 - 3.3.8.1 Inserts shall be stainless steel for installation in manholes in arterial and/or collector



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- roads. They shall be supplied with a 304 stainless handle and hardware, no vent, and a closed cell neoprene gasket.
- 3.3.8.2 HDPE inserts may be used for all other roads. The inserts shall have a woven nylon handle attached with 304 stainless hardware, structural ribbing, a closed cell neoprene gasket, and no vent.
 - 3.3.8.3 Inserts shall be supplied in accordance with Appendix B.
- 3.3.9 Flow channel(s) in the manhole base shall be formed of 4,000 psi concrete, Type II Portland cement.
- 3.3.9.1 The first manhole in each line shall have the flow channel extended full width of the manhole to accommodate a TV camera.
 - 3.3.9.2 Cut off pipes at inside face of the manhole within two inches of the manhole sidewall and construct flow channel(s) to invert of the pipe entering the manholes.
 - 3.3.9.3 Changes in direction of the gravity main and entering branch(es) shall be laid out in smooth curves of the longest possible radius which is tangent to the centerlines of adjoining pipelines.

3.4 MANHOLE FRAMES AND COVERS

- 3.4.1 Manhole frames and covers, for structures and for manholes, shall be heavy duty cast iron frames and covers designed for traffic loads.
- 3.4.2 Frames for manholes shall be pressure-tight base flange type.
- 3.4.3 The cover and frame castings shall meet the requirements of ASTM A48, Specifications for Gray Iron Castings, Class No. 35, or Grade 65-45-12 ductile iron meeting the requirements of ASTM A536, "Standard Specification for Ductile Iron Castings."
 - 3.4.3.1 Manhole frame and cover shall be designed to withstand an HS20-44 loading defined in the AASHTO Specifications.
 - 3.4.3.2 Frames and covers shall be machined or ground at touching surfaces so as to seat firmly and prevent rocking. Any set not matching perfectly shall be removed and replaced.
- 3.4.4 "SANITARY SEWER" shall be embossed in the cover.
- 3.4.5 Adjusting rings for adjusting existing manhole covers to new grade shall be heavy duty cast iron manhole adjusting rings for two-inch or greater adjustment, and for one-inch adjustment shall be steel adjusting rings. Rings shall be coated with an acid resistant coating as specified in Appendix B.

3.5 WATERPROOF AND PROTECTIVE COATINGS

- 3.5.1 Protective coating shall be applied to all interior surfaces of manholes when specified by the County. The waterproofing materials shall be applied in accordance with the instructions of the manufacturer by a manufacturer certified Contractor. Time shall be allowed between coats to permit sufficient drying so that the application of the second coat has no effect on the first coat. Special precaution shall be taken not to coat joint contact surfaces.
- 3.5.2 Interior linings of manholes shall be as approved in Appendix B. Cementitious linings shall be applied after installation of manholes.



PART 4.0 CONSTRUCTION

4.1 WORK AT HIGHWAY OR RAILROAD CROSSINGS

Construction work to be performed at any County/FDOT highway or railroad crossing shall not commence until all right-of-way permits for the pipeline occupancy have been obtained.

4.2 PRECONSTRUCTION PIPE INSPECTION/CERTIFICATION

4.2.1 The Contractor shall obtain from the pipe manufacturer a certificate of inspection to the effect that the pipe and fittings supplied for the project have been inspected at the plant and that they meet the requirements of these specifications.

4.2.1.1 For County Contracted projects, the Contractor shall submit these certificates to the Project Manager prior to installation of the pipe materials.

4.2.1.2 For developer projects, the Contractor shall submit these certificates to the PUD Inspector prior to the installation of the pipe materials.

4.2.2 Joints or fittings that do not conform to these specifications will be rejected and must be removed immediately by the Contractor.

4.2.3 The entire product of any plant may be rejected when, in the opinion of the County, the methods of manufacture fail to secure uniform results, or where the materials used are such as to produce inferior pipe or fittings.

4.2.4 For County Contracted projects all pipe and fittings shall be subjected to visual inspection at time of delivery and before they are lowered into the trench to be laid.

4.2.5 Hillsborough County requires a television inspection of the interior of the installed pipe prior to final acceptance. This inspection will be performed by the Contractor. All televising inspections must be monitored by the County inspector and the original video must be signed by the inspector. Television reports and tapes shall be supplied to the PUD Inspector.

4.3 INSTALLATION

4.3.1 The provisions set forth herein shall be applicable to all underground wastewater piping installations.

4.3.2 All connections to pipe, fittings, or apparatus shall be made plumb, so to ensure no negative pressure is placed or potential placed against the joint, or connection, thereby causing a malfunction or failure of the mechanical joint, or connection.

4.3.3 All pipe shall be color coded green.

4.3.4 It shall be the Contractor's and Developer's responsibility to verify all existing conditions and to locate all structures and utilities along the proposed utility alignment in order to avoid conflicts. Where conflicts exist, work shall be coordinated with the facility owner and performed so as to cause minimum interference with the service rendered by the facility disturbed.

4.3.5 Facilities or structures damaged shall be repaired and/or replaced immediately at the Contractor's and/or developer's expense, in conformance with current standard industry practices, according to the direction of the owner of such facility, and approved by the County.



- 4.3.6 See Specification 333006, Exhibit S-5 for Jack and Bore details and Exhibit S-6 for Ditch Crossing details.
- 4.3.7 No pipe shall be laid when the trench conditions or the weather is unsuitable for such work.
- 4.3.8 Polyvinyl chloride pipe may be damaged by prolonged exposure to direct sunlight. The Contractor shall take necessary precautions during storage and installation to avoid this damage. Pipe shall be stored under cover and sufficient backfill shall be placed to shield it from the sun as the pipe is installed.
- 4.3.9 Excavation, trenching and backfilling shall be in accordance with the requirements of the applicable portions of these specifications. Pipe installation shall conform to Uni-Bell Plastic Pipe Association Standard Uni-B-5 and ASTM 2321.

4.4 TRENCH EXCAVATION

- 4.4.1 All excavations shall be open cut, with banks of trenches kept as nearly vertical as possible and wide enough to allow approximately eight inches of clearance on each side of the pipe.
- 4.4.2 The trench floor shall provide a uniform bearing for each full length of pipe section. Excavate bell holes after trench has been graded. See Specification 333006 Exhibit S-15.
- 4.4.3 Perform all excavations, of whatever substance is encountered, to the depths shown or indicated on plans.
- 4.4.4 In the event unsuitable or unstable soil is encountered, remove it to a depth of 6 inches (minimum) below the bottom elevation of the pipe (12 inches if rock or boulders are encountered) and replace with material meeting AASHTO Soil Classification A-1, A-2, or A-3, as approved by the Project Manager or Engineer. Reference FDOT Standard Specifications for Road and Bridge Construction Section 125-4.
- 4.4.5 Dewatering: Remove all water from excavations and maintain the excavations free of water while construction therein is in progress. Provide dewatering equipment as necessary to conform to this requirement. Dewatering procedure must meet all regulatory requirements.
- 4.4.6 Protection of Trees: Trenching shall not take place within the root zone of trees with a trunk diameter six-inches or larger. The root zone shall be defined as the greater of one) the drip line of the tree or two) a circular zone extending outward from the base of the tree a distance equivalent to 1/2-foot for every inch of trunk diameter as measured 4-1/2 feet above natural grade (see Specification 333006 Exhibit S-7). Exotic nuisance species, such as Brazilian Pepper and Melaleuca, are exempt from this protection.

4.5 HANDLING AND CUTTING PIPE

- 4.5.1 Every care shall be taken in handling and laying pipe and fittings to avoid damaging the pipe, scratching or marring machined surfaces, and abrasion of the pipe coating.
- 4.5.2 Any fitting showing a crack, and any fitting or pipe which has received a severe blow that may have caused an incipient fracture (even though no such fracture can be seen) shall be marked as rejected and removed at once from the work.



- 4.5.3 In any pipe showing a distinct crack and in which it is believed there is no incipient fracture beyond the limits of the visible crack, the cracked portion, if so approved by PUD, may be cut off before the pipe is laid. The cut shall be made in the sound barrel at a point of at least 12 inches from the visible limits of the crack. All cutting shall be done with a machine adapted to the purpose. All cut ends shall be examined for possible cracks caused by cutting.
- 4.5.4 Cutting Pipe: The Contractor shall cut pipe by means of an approved mechanical cutter. The cut shall be perpendicular to the longitudinal axis of the pipe and rough ends or spurs will be satisfactorily removed prior to installation and seating.

4.6 PIPE LAYING

- 4.6.1 Pipe shall be constructed of the materials specified and as shown on the drawings.
- 4.6.2 Cradle: Upon satisfactory excavation of the pipe trench and completion of the pipe bedding, a trough recess for the pipe bells and joints (or couplings) shall be excavated by hand digging. When the pipe is laid in the prepared trench, true to line and grade, the pipe barrel shall receive continuous, uniform support and no pressure will be exerted on the pipe joints from the trench bottom.
- 4.6.3 Cleanliness: The interior of the pipes shall be thoroughly cleaned of all foreign matter before being gently lowered into the trench and shall be kept clean during laying operations by means of plugs or other approved methods. During suspension of work for any reason at any time, a suitable stopper shall be placed in the end of the pipe last laid to prevent mud or other foreign material from entering the pipe.
- 4.6.4 Gradient
- 4.6.4.1 Lines shall be laid straight, and depth of cover shall be maintained uniform with respect to finish grade, whether final grading is completed or proposed at time of pipe installation. When a grade or slope is shown on the Construction Drawings, means shall be used by the Contractor to assure conformance to required grade.
- 4.6.4.2 Any pipe which has its grade or joint disturbed after laying shall be taken up and re-laid.
- 4.6.5 Pipe/Joint Deflection: Whenever it is desirable to deflect PVC pipe/joints, the amount of deflection shall not exceed 75% of the maximum limit as specified in C605, or the manufacturer's recommendations, whichever is less.
- 4.6.6 Rejects: Any pipe found defective due to interior or exterior damage shall be immediately removed and replaced with sound pipe at the Contractor's expense.
- 4.6.7 Any section of pipe already laid which is found to be defective or damaged shall be replaced with new pipe without additional cost to the County.
- 4.6.8 Installation of PVC pipe and fittings shall be in accordance with the installation requirements established by the manufacturer and ASTM D2321.

4.7 INSTALLING JOINTS

- 4.7.1 The joints of all pipelines shall be assembled in straight alignment and made tight. The particular joint used shall comply with the requirements of Part 3.2. For County contracted projects, the particular joint used shall be reviewed and approved by the Engineer prior to installation.



- 4.7.2 Push-On Joints: Push-on joints shall be made in strict compliance with the manufacturer's recommendations.
 - 4.7.2.1 Lubricant shall be an inert, non-toxic, water soluble compound.
 - 4.7.2.2 Insert the spigot end into the bell so that it is in uniform contact with the gasket. Push the spigot until the reference mark on the spigot end is flush with the end of the bell. If the reference mark is not visible after assembly, the joint is to be cut out.
- 4.7.3 Joint Compounds: Sulfur based joint compounds shall not be used.

4.8 INSTALLING MANHOLES

- 4.8.1 The base section shall be set in the leveling course of crushed stone sub-base compacted to not less than 98% of maximum dry density as determined by the Modified Proctor Test ASTM D1557. See Part 4.10 for backfill and compaction requirements.
- 4.8.2 Manhole Riser Sections
 - 4.8.2.1 Sewer manhole risers shall be watertight.
 - 4.8.2.2 Construct cone section of manhole as detailed on the Construction Drawings. Make watertight connection between the cone section and the riser sections.
 - 4.8.2.3 Riser adjusting rings shall be a minimum of three inches to a maximum of 12-inches in height.
- 4.8.3 Manhole Frames and Covers
 - 4.8.3.1 Install a cast iron frame and cover for each manhole and adjust the frame and cover to proper grade. All castings shall be set flush in paved areas and flush with finished grade in unpaved areas unless shown otherwise on plans. Frame and cover shall be neatly grouted with non-shrink grout.
 - 4.8.3.2 Frames on manhole cones shall be set concentric with the masonry and in a full bed of mortar so that the space between the top of the manhole masonry and the bottom flanges of the frame shall be completely filled and made water tight.
 - 4.8.3.3 A ring of mortar at least one-inch thick and pitched to shed water away from the frame shall be placed around the outside of the bottom flange. Mortar shall extend up to the outer edge of the masonry and shall be finished smooth and flush with the top of the flange.

4.9 GRAVITY LATERALS

- 4.9.1 Open ends of laterals shall be securely sealed with appropriate stoppers as recommended by the pipe manufacturer.
- 4.9.2 Each lateral/cleanout location shall be marked with an "S" saw cut into the top of curb.
- 4.9.3 The cleanout(s) shall be extended 30–40 inches above design grade and shall be attached to a green painted wood two-inch by four-inch stake, per Specification 333006 Exhibit S-2A. On both single and double service cleanouts the final grade shall be marked on each cleanout two (2) inches from the top of the cleanout.
- 4.9.4 After connection to the building, the lateral cleanout shall be cut down to design grade and a cast iron valve box cover installed as shown in Specification 333006 Exhibit S-2B.



4.10 BACKFILL/COMPACTION

- 4.10.1 Backfilling and compaction shall be conducted in a manner as to preclude subsequent settlement and provide adequate support for the surface treatment, pavement, pipelines, or structures to be placed thereon. All trenches shall be prepared per the requirements of Part 4.4.
- 4.10.2 Backfill and bedding material shall be common fill material free from organic matter, muck or marl, and rock exceeding 2-1/2 inches in diameter, and shall not contain broken concrete, masonry, rubble or other similar materials. When unstable or unsuitable material is encountered replace with AASHTO soil classification A-1, A-2, or A-3.
- 4.10.3 Method of Compaction: The Contractor shall adopt compaction methods which will produce the degree of compaction specified herein without damage to the new or existing facilities. The degree of compaction specified in the following shall be considered the minimum allowable.
- 4.10.4 Backfilling Procedures: The backfilling procedures outlined in the following shall be for wastewater mains and related structures.
- 4.10.4.1 Wastewater Mains
- a) In the first stage, the Contractor shall provide adequate compacted fill beneath the haunches of the pipe, using mechanical tampers suitable for this purpose. This compaction applies to the material placed beneath the haunches of the pipe and above any bedding material. Fill compacted by mechanical compactors shall be placed in six-inch layers and thoroughly tamped over the entire surface.
 - b) In the second stage, the Contractor shall obtain a well-compacted bed and fill along the sides of the pipe and to a point of at least one foot above the top of the pipe. The width of backfill and compaction to be done under this second stage shall be the width of the portion of the trench having vertical sides; or, when no portion of the trench has vertical sides, it shall be to a width at least equal to three times the outside diameter of the pipe. Material to be placed in six-inch layers (loose thickness).
 - c) In the third stage, the remainder of the trench shall be backfilled with suitable material in layers not to exceed 12-inch loose thickness and compacted.
- 4.10.4.2 Manholes
- a) The Contractor shall provide well-compacted sub-base under the manhole per Part 4.8.1.
 - b) From the bedding up to grade the Contractor shall backfill around the manhole in lifts not to exceed 12 inch layers (loose thickness). The width of the backfill and compaction shall be the width of the excavation, or to a width equal to three times the manhole diameter whichever is less.
- 4.10.5 Compaction Density: The excavation backfill density for all stages shall be provided as follows:
- 4.10.5.1 From right-of-way line to right-of-way line, and including all structures and railroad crossings: Compaction shall be 98% of the maximum density as determined by AASHTO T-180 (ASTM D1557 - Modified Proctor) with no tolerance.
- 4.10.5.2 For outside of the right-of-way (but within maintenance easements): Compaction shall be 95% of the maximum density as determined by AASHTO T-180 (ASTM D1557 - Modified Proctor) with no tolerance.
- 4.10.6 Compaction Test Requirements
- 4.10.6.1 Compaction test results shall be submitted for all work.
- 4.10.6.2 Results of compaction tests must meet minimum requirements prior to proceeding with



the next stage of the work.

- 4.10.6.3 For developer projects, one complete set of all test reports shall be submitted with the as-built package to the Site Plan and Subdivision Review Section upon project completion.
- 4.10.6.4 For County run projects, one complete set of all test reports shall be submitted with the as-built package to the Project Manager upon project completion.
- 4.10.6.5 The Contractor shall employ an independent testing laboratory, acceptable to the County and pay for all required tests.
- 4.10.6.6 The laboratory shall submit one copy of the certified test reports, after testing in each phase, to the Construction Services Section in the Development Services Department, or the County Project Manager (as applicable), for approval.
- 4.10.6.7 In the second and third stage of backfilling, density tests shall be made every one foot vertically, staggered every 200 feet (minimum) horizontally. There shall be a minimum of one test (per vertical foot) between structures, and a minimum of one test per day.
- 4.10.6.8 For manholes, density tests shall be every two feet vertically, staggered spirally around the manhole, and a minimum of one test per day.

4.11 CONNECTIONS TO GRAVITY SYSTEMS

- 4.11.1 Connections to the existing sanitary sewer system shall be made as shown the Construction Drawings. Coordination between the County and the Contractor shall be required in order to accomplish this task. The Contractor shall supply a connection schedule to the County two weeks prior to the proposed connections. Connections 6” and less shall be made through a lateral connection into the existing gravity line. Connections 8” and greater shall connect into an existing manhole.
- 4.11.2 After approval of the schedule, the County will be responsible for shutting down any County owned pump stations or valves as applicable. The Contractor will then make the required connection as quickly as possible. The Contractor shall be responsible for the coordination of any/all of the existing private pump stations shut-down. The Contractor is responsible to coordinate and provide any and all pumping, bypass pumping and/or removal of effluent at connection points to existing mains and at affected pump/lift stations (County owned or private) during wastewater connection operations. Contractor is also responsible for any trucking of effluent and the proper disposal of wastewater, and any other work required to maintain existing services until and during transfer to the new service.
- 4.11.3 Connections to an existing manhole shall be made after complete flushing of the new system and shall be made under the direction of Hillsborough County PUD.
- 4.11.4 The Contractor shall cut suitable openings into the existing manholes or remove the existing pipe to accommodate the pipelines as indicated on the Construction Drawings and as herein specified. The portion of each existing structure removed for new installation shall be confined to the smallest opening possible, consistent with the work to be done.
- 4.11.5 The manhole shall be properly prepared to receive the connection by carefully coring drilling the wall of the existing manhole through the use of mechanical drilling equipment. The perimeter of the penetration shall not be closer than 12 inches to a barrel section joint.
- 4.11.6 A flexible resilient watertight connector shall be installed prior to pipe insertion into the manhole.



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- 4.11.7 Any penetration to a manhole liner, or coating, must be properly sealed to restore the integrity of the liner/coating.
- 4.11.8 After the pipe is installed the Contractor shall carefully repair the existing manhole invert in accordance with manufacturer recommendations and in a manner satisfactory to Hillsborough County PUD Project Manager, or Inspector, as applicable. Manhole inverts shall be reshaped as required by the new connection to provide a smooth flowing channel of the exact shape of the gravity main to which it connects.

4.12 TAKING EXISTING WASTEWATER SYSTEMS OUT OF SERVICE

- 4.12.1 Existing wastewater gravity pipelines shall be taken out of service when indicated on the Construction Drawings. When lines are taken out of service, backfill the line with flowable fill (FDOT Standard Specifications for Road and Bridge Construction Section 121) or grout if the line is not removed.
- 4.12.2 Existing wastewater systems to be taken out of service shall be plugged after the relief interceptor and appurtenances downstream have been constructed, successfully tested, and approved by the Engineer, and after the County permits the existing wastewater system to be taken out of service.
- 4.12.3 The upper portion of manholes to be taken out of service shall be removed to not less than 36 inches below the proposed finish grade. The remaining portion of the structure shall be filled with sand or other approved granular fill material. The material used to fill the abandoned structure shall be clean, granular, well graded and free of any organic matter or deleterious material. Before filling, the bottom shall be punctured with a hole of 6-inch (minimum) diameter.

4.13 INSPECTION AND TESTING

- 4.13.1 General
 - 4.13.1.1 All construction in existing or proposed public right-of-way will be inspected by a representative of PUD for compliance with approved construction plans and requirements of the PUD Technical Specifications. The level of inspection will be based on the size and complexity of the project.
 - 4.13.1.2 All projects shall be tested upon completion of installation. The Project Manager, or PUD Inspector (as applicable), shall designate the locations of tests and extent of the system to be tested, approve the method of testing leakage (air or water), alignment and deflection and the requirements for recording test results. All manhole risers and gravity lines (including laterals) shall be tested for leakage. Roads shall not be paved until all PUD utilities under the pavement have passed inspection.
 - 4.13.1.3 For developer projects it is the responsibility of the developer to have all testing performed; any repairs (as required) completed; and turn over a report certifying completion and results of the tests, and compliance with County and State standards to the PUD Inspector prior to acceptance of their projects. At the discretion of the County, any system that is not in service within 9 months of being inspected shall be re-inspected before project acceptance and release of the performance bond.
 - 4.13.1.4 For County run projects it is the responsibility of the Contractor to perform all tests; repair all defects; and turn over a report certifying completion and results of the tests, and compliance with County and State standards to the Project Manager prior to substantial completion.
 - 4.13.1.5 The County will require the Contractor to supply all materials and equipment required



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to perform the required tests to assure that all pipe and appurtenances installed meet the County's infiltration/exfiltration rates. All tests shall be witnessed by the Engineer of Record, or their representative. Notify the Engineer of Record, or their representative, a minimum of seven days in advance of all tests.

- 4.13.1.6 All pressure gauges used in testing shall be calibrated, within six months prior to use, by an independent testing agency. A copy of the calibration report shall be submitted to the Project Manager, or PUD Inspector (as applicable). Test gauges for air tests shall have the following characteristics.
 - a) Range: 0 to 30 psi, maximum
 - b) Minor Gradation: 0.1 psi, maximum
 - c) Accuracy: plus or minus 0.5 percent of range
 - 4.13.1.7 Adequately brace and support all piping during testing so that no movement, displacement, or damage shall result from the application of test pressures.
 - 4.13.1.8 All equipment used in testing and/or repairs shall be subject to the approval of Hillsborough County PUD and shall be such as to properly develop, maintain, and measure test pressure.
 - 4.13.1.9 Piping shall be backfilled before testing
 - 4.13.1.10 If any manhole or section of the sewer fails to pass the tests, the Contractor shall perform an inspection of the faulty section, locate the defects, and repair or replace at his own expense all defective materials or workmanship.
 - a) Make repairs to the various systems with new materials.
 - b) No caulking of threaded joints, cracks, or holes, will be acceptable.
 - c) Where it becomes necessary to replace pieces of pipe, the replacement shall be the same length material and thickness as the defective piece.
 - d) If repairs are necessary, the Contractor shall obtain the Project Manager's, or the PUD Utility Design Section Manager (as applicable), approval for all materials and methods. Repeat tests after disclosed defects have been corrected, until piping system passes test to the satisfaction of the Project Manager, or Engineer of Record (as applicable).
 - 4.13.1.11 Prior to tests, all gravity lines shall be cleaned and tested for major defects by flushing with an appropriately sized cleaning ball. Pre-cleaning by high velocity jet or other methods may be necessary.
 - 4.13.1.12 All strength specified concrete shall be tested and results submitted to the PUD Inspector for sign off acceptance.
- 4.13.2 Television Inspection of Gravity Mains and Laterals
- 4.13.2.1 Hillsborough County requires that completed wastewater gravity mains and laterals be televised prior to final acceptance. The inspection will be performed by/is the responsibility of the developer for developer run projects, and by the Contractor for all County run projects.
 - 4.13.2.2 All televising inspections must be witnessed by the Project Manager, or PUD Inspector (as applicable). Television reports and tapes shall be supplied to the County by the responsible party. The original video must be signed by the Project Manager, or the PUD Inspector that witnessed the testing. Detailed televising procedures are in Part 5 herein.
 - 4.13.2.3 All gravity lines shall be inspected visually to verify accuracy of alignment and freedom from debris and obstruction. The full diameter of the pipe shall be visible when viewed between consecutive manholes. The method of test will be closed circuit television.
 - 4.13.2.4 For developer projects, the PUD Inspector will coordinate television inspection by the developer of the project. This is to assure that any irregularities in the completed pipe line are not going to be transferred to the County for ownership and maintenance.



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- 4.13.2.5 For County projects, the Project Manager shall coordinate the television inspection by the Contractor of the project.
- 4.13.3 Air Testing Wastewater Systems
- 4.13.3.1 The Contractor may desire to make an air test prior to backfill for his own purposes, but the line acceptance test shall be conducted after backfilling has been completed in accordance with other portions of these specifications.
- 4.13.3.2 All wyes, tees, or ends of lateral stubs shall be suitably capped to withstand the internal test pressures. Such caps shall be easily removed for future lateral connections or extensions.
- 4.13.3.3 After a manhole-to-manhole section of line has been backfilled and cleaned, it shall be plugged at each manhole with pneumatic plugs inflated to 30 psig (pounds per square inch gauge) internal pressure. The design of the pneumatic plugs shall be such that they will hold against the line test pressure without requiring external blocking or bracing, although blocking and bracing is recommended for personal safety.
- 4.13.3.4 Low pressure air testing shall comply with the requirements of ASTM F1417
- 4.13.3.5 There shall be three hose connections to the pneumatic plug. One hose shall be used only for inflating the pneumatic plug. The second hose shall be used for continuously reading the air pressure rise in the sealed line. The third hose shall be used only for introducing low pressure air into the sealed line.
- 4.13.3.6 Low pressure air shall be introduced into the sealed line until the internal air pressure reaches four psig greater than the average back pressure of any groundwater pressure that may be over the pipe. At least two minutes shall be allowed for the air pressure to stabilize. After the stabilization period, the internal air pressure shall be pressurized to the final test pressure, and the third hose shall be disconnected.
- 4.13.3.7 The portion of line being tested shall be accepted if the portion under test does not lose air at a rate greater than 0.0015 cfm (cubic feet per minute) per square foot of internal pipe surface of the pipe length under test when tested at an average pressure of 3.5 psig greater than any back pressure exerted by groundwater that may be over the pipe at the time of the test.
- 4.13.3.8 The previous requirements shall be demonstrated by performing the test as follows:
- a) The time requirement for the pressure to decrease from 3.5 to 2.5 psig (greater than the average backpressure of any groundwater that may be over the pipe) shall not be less than the time indicated in ASTM F1417.
 - b) In areas where groundwater is known to exist, the Contractor shall install a 1/2-inch diameter capped pipe nipple, approximately 10 inches long, through the manhole wall level with the top of the wastewater lines entering the manhole.
 - 1) This shall be done at the time the sewer main is installed.
 - 2) Immediately prior to the performance of the line acceptance test, the groundwater level shall be determined by removing the pipe cap, blowing air through the pipe nipple into the ground so as to clear it, and then connecting a clear plastic tube to the pipe nipple.
 - 3) The tube shall be held vertically and a measurement of the height in feet of water shall be taken after the water stops rising in this plastic tube.
 - 4) The height in feet shall be divided by 2.31 to establish the pounds of pressure that will be added to all readings.
- 4.13.3.9 If any section of the wastewater system fails to meet this requirement, the Contractor shall perform an inspection of the faulty section and repair or replace, at his own expense, all defective materials or workmanship. The test procedure shall be repeated until the results are acceptable.



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4.13.4 Water Infiltration/Exfiltration Testing

4.13.4.1 Wastewater Manhole Risers

- a) Air testing is not acceptable for use on Manhole Risers.
- b) All wastewater manhole risers shall be tested for leakage by plugging pipelines and filling the manhole with water to the top of the manhole.
- c) The test period shall be for 24 hours and during the test period, the water level shall not drop.
- d) The PUD Inspector is required to sign off all manhole leakage tests.

4.13.4.2 Infiltration Testing of Wastewater Systems

- a) Where the groundwater elevation is four feet or higher than the crown of the pipeline the Contractor may desire to test the wastewater system for infiltration rather than air testing.
- b) Infiltration testing shall be in accordance with ASTM C443.
- c) The allowable rate of infiltration shall not exceed 50 gallons per inch of internal diameter of pipe/mile of pipeline/day, when the hydrostatic pressure at the centerline of the pipe doesn't exceed 25 feet. No visible leakage shall be allowed.
- d) If any section of the wastewater system fails to meet this requirement, the Contractor shall perform an inspection of the faulty section and repair or replace at his own expense all defective materials or workmanship. The test procedure shall be repeated until the results are acceptable.

4.13.4.3 Exfiltration Testing of Wastewater System

- a) Where the groundwater elevation is less than four feet above the crown of the pipeline, the Contractor may desire to test the wastewater system for exfiltration rather than air testing.
- b) Plug the pipeline to be tested at the downstream manhole and fill the line with water. The test shall run for 24-hours minimum. The water level inside the manhole should be two feet higher than the top of the pipe or two feet higher than ground water level, whichever is greater. The maximum internal pipe pressure at the lowest end should not exceed 25 feet of water or 10.8 psi.
- c) The allowable rate of exfiltration shall not exceed 50 gallons per inch of internal diameter of pipe/mile of pipeline/day.
- d) If any section of the wastewater system fails to meet this requirement, the Contractor shall repair or replace at his own expense all defective materials or workmanship. The test procedure shall be repeated until the results are acceptable.

4.13.5 Deflection Tests: PVC Pipe

4.13.5.1 Maximum allowable pipe deflection (reduction in vertical inside diameter) shall not exceed 7-1/2%.

4.13.5.2 The Project Manager, or PUD Inspector (as applicable), may determine that deflection testing is unnecessary when using proper construction practices and inspection during pipe installation and when using embedment material which has been properly selected, placed and compacted. However, random deflection testing of pipe may be required at locations where construction encountered unstable trench walls or bottoms, heavy rainfall, high ground water levels, deep lines, difficulty in obtaining compaction, or where other problems are indicated.

4.13.5.3 Locations with excessive deflection shall be excavated and repaired by re-bedding or by replacing pipe. Optional devices for testing include a deflecto-meter, a properly sized "go, no go" mandrel or sewer ball.

4.13.5.4 For the purpose of deflection measurements, the base inside pipe diameter without deflection is provided in the following table.



- a) The maximum allowable deflection should be applied to the base inside diameters in determining the minimum permissible diameter.
- b) To insure accurate testing, the lines must be thoroughly cleaned.

Base Inside Diameter for Deflection Measurements of ASTM D3034 DR26 PVC Sewer Pipe

Size	Avg. O.D.	t	1.06t or t'	Avg. I.D.	Base I.D.	7-1/2% Deflection I. D.
4"	4.215	0.162	0.171	3.872	*	3.58"
6"	6.275	0.241	0.256	5.764	5.612	5.19"
8"	8.400	0.323	0.342	7.715	7.488	6.93"
10"	10.500	0.404	0.428	9.644	9.342	8.64"
12"	12.500	0.481	0.510	11.480	11.102	10.27"
15"	15.300	0.588	0.623	14.053	13.575	12.56"

* 4" ID pipe use Average ID

4.13.5.5 If the Contractor performs the deflection testing rather than employing an approved test lab, the Contractor shall furnish the mandrel, labor, materials, and equipment necessary to perform the tests as approved by the Project Manager, or PUD Inspector (as applicable).

- a) The mandrel shall be pulled through by hand or a hand operated reel in the presence of the Project Manager, or PUD Inspector.
- b) Prior to performing the deflection tests, the Contractor shall submit certification that the 9-arm mandrels are preset as previously stated.
- c) Each mandrel shall be engraved with the following:
 - 1) Serial Number
 - 2) Nominal pipe diameter
 - 3) "ASTM D 3034" and either "SDR-26"
 - 4) % deflection as previously stated

4.13.5.6 If the mandrel fails to pass any section of pipe, the Contractor shall excavate to the point of excess deflection and carefully compact around the point where excess deflection was found. After the permanent pavement base has been compacted and resealed, the line shall be retested. If the mandrel fails to pass a second time, the section shall be replaced. Re-rounding is not permitted.

PART 5.0 TELEVISIONING OF LINES

5.1 PROCEDURES FOR TELEVISIONING SANITARY SEWER MAINS

5.1.1 The following procedures shall be followed on all sanitary sewer mains which are to be accepted by the County.

5.1.2 All sanitary sewer mains will be televised utilizing a 360-degree pan and tilt color camera. The camera shall be of the self-propelled tractor type, with a measuring device mounted to the front capable of being read as the tractor moves and capable of accurately measuring depth of standing water up to and including one inch. A pull type camera may be used only as a system backup.

5.1.3 All sanitary sewer mains with less than eight-foot of compacted backfill above the main shall require the base to be placed and compacted prior to televising. All mains not filled to subgrade



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will have at least 10-foot of compacted backfill.

- 5.1.4 All sanitary sewer mains shall be televised in an upstream direction wherever possible.
- 5.1.5 Inverts will be constructed in manholes prior to televising.
- 5.1.6 Televising for the Contractor's own use may be done at any time; however, the County inspector shall be present during all televising for acceptance and the procedures listed herein shall be followed.
- 5.1.7 Mains shall be flushed and cleaned prior to televising
- 5.1.8 At least 24 hours prior to, and no more than 48 hours prior to televising, sufficient water shall be run through each section of main until water runs through each downstream manhole. No lines shall be televised which are dry or that enough water has not run through to reach the end of each section.
- 5.1.9 Mains which are dirty (dirty walls and/or debris in the inverts) shall be re-flushed and cleaned before rescheduling another televising with the County inspector. The County inspector may require pigging of specific sections, if necessary.
- 5.1.10 There shall be no dips in the mains. Any dips which are found shall be reviewed and a decision made by the County Inspection Section as to whether to accept the main as is or to have the dip removed. Decisions will be made on a case-by-case basis; however, normally any dip one-inch or greater will be required to be removed.
- 5.1.11 The Contractor shall be entitled to a second inspection on lines requiring repairs. Second inspections for dirty lines and additional inspections for repairs after the second free inspection shall be billed by the County for each section of main televised.
- 5.1.12 The County inspector will initial each video tape utilized in televising and that tape will be submitted to the County for its records. Copies of the original tape will not be accepted. The original tape and the televised reports shall be submitted to the County prior to the inspector signing-off on the project.