

DIVISION 2 - SITE WORK
SPECIFICATION 02081.2
WASTEWATER FORCE MAINS AND APPURTENANCES**PART 1 - GENERAL**

02081.2 - 1.1 DESCRIPTION

- A. The following specification covers the design, installation, inspection, testing, and acceptance of wastewater force main systems. Construction consists of furnishing all labor, equipment, tools, appliances and materials for performing all operations necessary for the construction and installation of wastewater force mains, including all wastewater, sewage sludge, raw sewage and effluent piping, valves, valve boxes, casings, and appurtenances, complete and ready for operation, as indicated 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.
- B. The Contractor shall furnish to the County a two (2) year warranty on the design, materials, fabrication, and workmanship of any and all ductile iron pipe and fittings, and polyvinyl chloride pipe furnished and installed. Warranty period shall commence upon written acceptance of particular component or appurtenance by County for ownership and operation.
- C. All construction plans and record drawings shall comply with the requirements of Section 2 of the Hillsborough County Water Resource Services (HCWRS) Technical Manual.

02081.2 - 1.2 REFERENCE DOCUMENTS

- A. American Association of State Highway & Transportation Officials (AASHTO).
- B. American Concrete Institute (ACI)
- C. American National Standard Institute (ANSI)
- D. American Society of Mechanical Engineers (ASME)
- E. American Society of Sanitary Engineers (ASSE)
- F. American Society for Testing and Materials (ASTM)
- G. American Water Works Association (AWWA)
- H. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS)
- H. NSF International (NSF)
- I. Portland Cement Association (PCA)

02081.2 - 1.3 SHOP DRAWINGS AND SUBMITTALS

- A. For County run projects, shop drawings and related manufacturer's product certification 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 which require shop drawings are brought to the Contractor's attention. The list may not include all items for which shop drawing submittals are required to meet the requirements of the project.
 - 1. Detail drawings of all classes of pipe, joints, and fittings.
 - 2. Detail Drawings of restrained and flexible joints, including test reports to confirm thrust restraint capacities and restraining mechanism application.
 - 3. 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,

- valves service connections and other important features of the pipeline.
4. Detail drawings of all Jack and Bore Pits.
 5. Line Connections.
 6. Valves and Valve Boxes.
 7. All Appurtenant Items.
 8. Contractor's flushing and testing plans for all gravity system piping supplied.
- B. Certification and test reports for the materials, manufacturing, and testing of the types of pipe 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.

02081.2 - 1.4 RELATED WORK

- A. All Sections of Division 2.
- B. All Sections of Division 3.
- C. HCWRS Technical Manual

PART 2 – DESIGN

02081.2 – 2.1 FLOW CRITERIA-

- A. 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.
- B. Industrial and commercial design flows for sanitary wastewater shall be in accordance with Table 1 of the County's Utility Rate Resolution. Wastewater gravity collection systems, pumping stations, and force mains shall be designed for average daily flow times the appropriate peak factor as shown in part 5 herein.
- C. Force mains shall be designed to maintain a minimum velocity of 2 feet per second (fps). For design friction losses in force mains calculated using the "Hazen-Williams" formula, the value for "C" shall not exceed "C=100" for unlined iron or steel pipe, and "C=120" for smooth pipe materials such as PVC and lined ductile iron.

02081.2 - 2.2 MINIMUM LINE SIZE

- A. The minimum size force main constructed within County road Rights-of-Way or dedicated easements shall not be less than 4 inches in diameter.
- B. Force mains shall be sized to carry the full development peak flow (ref. part 2.1.B) from all connected pumping stations within the designated stations service area. Each force main system should be capable of transporting the peak flow from each pump station operating simultaneously without producing excessive pressure, i.e., not to exceed 100 feet Total Dynamic Head (TDH) anywhere in the system.

02081.2 - 2.3 DEPTH OF COVER

- A. The depth of cover, as measured from finished grade to the top of the pipe, within County Right-of-Way or easement, shall be not less than 36 inches.
- B. When automatic air release valves are required, additional cover (enough to maintain the valve

vault flush with the existing or proposed grade) shall be incorporated into the design.

02081.2 - 2.4 HORIZONTAL SEPARATION

- A. Wastewater force mains shall be laid at least 10 feet horizontally from any existing or proposed potable water main.
- B. A three foot horizontal separation shall be maintained between a wastewater force main and all other pipelines. The distance shall be measured face to face. In cases where it is not practical to maintain a ten-foot separation, see Appendix D for details.

02081.2 - 2.5 CROSSINGS

- A. Vertical separation between wastewater force mains crossing potable water mains, reclaimed water mains, or storm water lines shall be a minimum vertical distance of 18 inches between the outside of the water main, reclaimed water main, or storm water line and the outside of the wastewater force main. This shall be the case where the other pipeline is either above or below the wastewater main.
- B. Potable water main crossings below the wastewater line should be avoided whenever possible. The crossing shall be arranged so that the wastewater main joints will be equidistant and as far as possible from the water (potable, reclaimed, or storm) main joints.
- C. If the above vertical separation is not possible, see Appendix D.

02081.2 – 2.6 PIPE, FITTINGS, AND APPURTENANCES

- A. All force main piping shall be Polyvinyl Chloride (PVC) except as specified in 2.6.C. and D. below. Above ground discharge piping at pump stations shall comply with the requirements in Hillsborough County Technical Specifications 02081.3 and 02081.4.
- B. All fittings shall be ductile iron and comply with the requirements of Part 3 herein.
- C. The minimum design working pressure shall be:
 - 1. 150 psig (min), and a laying length of 20 feet, for 4 inch through 12-inch sizes
 - 2. 165 psig (min), and a laying length of 20 feet, for 16-inch through 36-inch sizes
- D. Aerial Crossing pipe; Pipe attached to a bridge or drainage structure; and Subaqueous pipe shall be ductile iron.
- E. RESTRAINED JOINTS
 - 1. Restrained joints shall be installed wherever force main pipe alignment changes direction.
 - 2. The length of pipe to be restrained shall be noted on the drawings.
 - 3. Shop drawings from the manufacturer shall be submitted to and approved by the Engineer prior to actual construction. Refer to part 1.3.
 - 4. Thrust blocks are not allowed in the HCWRS distribution system
- F. Road crossings of collector and arterial roads shall be cased. The casing shall extend a minimum of 2' beyond the back of curb.

02081.2 – 2.7 VALVES

- A. ISOLATION VALVES
 - 1. New force mains connecting to existing force mains shall include a shutoff plug valve at the point of connection.

2. The distance between in-line (isolation) valves shall not exceed 1,000 feet for force mains 12 inches in diameter or less.
 3. For line sizes greater than 12 inches, the maximum distance between in-line valves shall be approved on a case-by-case basis.
 4. Valves shall be readily accessible, and located in an area not subject to flooding. Valves shall not be located below the top of bank within a stormwater “ditch”.
- B. AIR RELEASE VALVES
Construction plans and record drawings shall include air release valve stationing and a detailed plan and profile view
- C. VALVE BOXES
1. Valve boxes installed below ground shall be cast iron.
 2. They shall be adjustable to fit the depth of earth cover over the valve and shall be designed so as to prevent transmission of surface loads directly to the valves.

02081.2 – 2.8 CONNECTIONS TO COUNTY SYSTEMS

- A. GENERAL
1. All connections to existing County systems shall be approved by the County
 2. All connections to existing force mains shall be made under the direct supervision of HCWRS.
- B. CONNECTING TO GRAVITY SYSTEMS
1. Force main connections to gravity systems are strongly discouraged. These connections will be approved only when absolutely necessary and only when proper precautions are taken to protect the existing infrastructure and to control odors. All requests must be submitted to the Water Resource Services (WRS) Design Team Leader for approval.
 2. Force main connections to the County gravity system shall comply with the requirements of specification 02081.1

PART 3 - PRODUCTS

02081.2 – 3.1 MATERIAL

- A. The following table lists the allowable pipe materials for various sizes of wastewater force main pipe:

DIAMETER	MATERIAL	GENERAL SPECIFICATIONS
4” to 12”	PVC	ASTM 2241 SDR 21
4" to 12"	PVC	AWWA C900 DR 18 AWWA C909 Class 200
4" to 12"	DIP	ANSI/AWWA C151/A21.51, CL 54
16" and Greater	PVC	AWWA C905 SDR 25

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

02081.2 – 3.2 POLYVINYL CHLORIDE PIPE AND FITTINGS

- A. All PVC pipe shall bear the approval of the National Sanitation Foundation (NSF) that will remain legible during normal handling, storage and installation. PIPE COLOR SHALL BE GREEN FOR FORCE MAINS.
- B. PVC resin compound shall conform to the requirements of ASTM D1784.
 - 1. Polyvinyl chloride (PVC) pipe four (4) inches through twelve (12) inches in diameter shall conform to the requirements of:
 - a. ASTM D2241, with a dimension ratio (DR) of 21 and a minimum pressure rating of 200 psi at 23° C (73.4°F.), for unthreaded pipe.
 - b. ANSI/AWWA C900, SDR 18 or ANSI/AWWA C909, Class 200.
 - c. Thrust-restrained pipe, 4” in size, or installed under roadway pavement in sizes 4” through 12” shall be Certalok, C900 Class 200, DR-14. Pipe shall be furnished in standard laying lengths of 20 ft. ± 1 in. See 02072 for additional requirements.
 - 2. Pipe 16 inches in diameter and larger shall meet all requirements of AWWA C905, SDR 25.
- C. All PVC that is not buried shall be formulated for sunlight exposure and shall pass the impact strength test as described by ASTM D2444, latest revision, using Tup A with impact level of 94 ft.-lbs
- D. FITTINGS
Fittings for PVC pipe shall be ductile iron fittings and comply with part 3.3.A below.
- E. JOINTS
 - 1. PVC pipe shall have provisions for expansion and contraction provided in the joints.
 - 2. All joints shall be designed for push-on makeup connection. A push-on joint may be an elastomeric-gasket bell end coupling manufactured as an integral part of the pipe barrel consisting of an integral wall-thickened bell end section with a ring groove to retain an elastomeric sealing ring of uniform cross-section as approved in Appendix B for PVC pipe.
 - 3. Restrained Joints: Restrained joints for PVC pipe shall be as approved in Appendix B. See 02081.6, exhibits S-11A & S-11B. The length of pipe to be restrained shall be noted on the Construction Drawings.

02081.2 – 3.3 DUCTILE IRON PIPE AND FITTINGS

- A. FITTINGS
 - 1. Ductile iron fittings shall be mechanical joint with a minimum pressure rating of 250 psig, shall conform to the requirements of ANSI/AWWA C110/A21.10 or C153/A21.53. Coatings shall comply with 4.3.6 (protective interior ceramic epoxy coating) and 4.3.2 (external coating) of the above standards. Ductile iron fittings and coatings shall be as

- approved in Appendix B.
2. All pipe fittings shall bear the NSF approval seal .
- B. AERIAL CROSSING PIPE, HANGERS, AND ACCESSORIES**
1. Pipe designated for use in aerial crossings and/or attachment to bridge or drainage structures shall be ANSI/AWWA C151/A21.51, Class 54 (minimum) ductile iron pipe.
 2. Pipe length shall correspond to "Long Span Pipe", D.I.P. for restrained joint
 3. Pipe joints shall consist of Mechanical Joint-Flange, (MJ-FLG), or Flange-Plain End, (FLG-PE), and Flange-Restrained Joint, (FLG-RJ). The flange joint end shall be equipped with an O-ring gasket.
 4. The DIP shall be ordered to fit the job. No field cuts will be allowed.
 5. All ductile iron pipe shall have an interior ceramic epoxy coating as specified in Appendix B. The Water Resource Services will consider using a steel casing around PVC for pipe attached to drainage structures.
- 6. HANGERS AND ACCESSORIES**
- a. Anchor Bolts - Anchor bolts shall be 316 stainless steel, installed in accordance with the Construction Drawings, utilizing non-shrink grout
 - b. Roller Stands - Roller stands and roller axles shall be type 316 stainless steel
 - c. Insulated Pipe Rollers - Pipe support rollers shall be constructed of dielectric synthetic resin.
 - d. Link Seal and Sleeve-Seals shall be modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and wall opening. Links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and nut
 - e. Hangers shall be made in accordance with standard practice MSS SP-58, and in full compliance with Federal Specification WW-H-171E and the ANSI/ASME Code for pressure piping B 31.1.
- C. SUBAQUEOUS SERVICE PIPE**
1. All pipe for river crossing or subaqueous crossing shall be shown on the plans shall meet the requirements herein
 2. All pipe shall be ductile iron pipe centrifugally cast per ANSI/AWWA C151/A21.51. The pipe shall be Class 55 (min).
 3. All pipe shall have an exterior bituminous coating in accordance with ANSI/AWWA C151/A21.51. Pipe interior shall be coated with a ceramic epoxy coating as specified in Appendix B
 4. The pipe joints shall be of the ball and socket type, capable of 15° free deflection in each joint with no reduction in the waterway.
 5. Each joint shall be self restrained without the use of bolts or similar external locking devices. Locking retainer glands shall be ductile iron or high strength alloy steel.
 6. Gaskets shall be designed to fit into the gasket seat. It shall not be displaced from its seat when the joint is assembled and in any stage of deflection, under pressure or vacuum.
 7. Pipe shall be furnished with the necessary gaskets, lubricant, and retainer locking accessories.

02081.2 – 3.4 GASKETS

Pipe and fitting gaskets, conforming to ANSI/AWWA C111/A21.11, shall be made of viton

(fluorocarbon elastomer), EPDM (ethylene propylene diene monomer) or SBR (styrene-butadiene rubber).

02081.2 – 3.5 VALVES AND APPURTENANCES

A. GENERAL

1. All valves shall be the manufacturer's standard design for the service intended and shall bear the maker's name and pressure rating cast on the body, also the valve type, size, flow direction arrow, if applicable.
2. Valves shall open left (counter clockwise) with an arrow cast in the metal of operating hand wheel or nuts indicating the direction of opening.
3. See Appendix B for acceptable valves. Details on specific valves are as follows.
4. Valve ends shall be flanged for all above ground installations and shall follow the general requirements as specified in 02081.3 "Wastewater Pumping Stations."

B. PLUG VALVES

1. Plug valves shall be full port and meet the requirements of AWWA C504 and C550.
2. Valves shall have mechanical joint ends and shall be furnished complete with joint accessories.
3. Valves shall be coated with an epoxy coating applied to both the exterior and the interior surfaces prior to assembly of the valves.

C. TAPPING VALVES

1. Tapping valves shall be mechanical joint outlet, non-rising stem, with a 2" operating nut resilient seat gate valves with O-ring seals meeting the applicable requirements of ANSI/AWWA C509 and C550. All tapping valves shall be coated with a fusion bonded epoxy coating applied to both the exterior and the interior surfaces prior to assembly of the valves. Tapping valves shall be furnished with a combination flange and mechanical joint for connecting the branch to the main.
2. Tapping valves shall be specifically designed for pressure tapping with sufficient seat opening to allow full diameter taps to be made.
3. Tapping valves shall be manufactured with an integral tapping flange having a raised face or lip designed to engage the corresponding recess in the tapping sleeve flange in accordance with MSS SP60.
4. Tapping valves without the raised face on the tapping flange are not permitted since they do not assure the proper alignment required to prevent damage by a misaligned shell cutter.
5. The tapping valve shall be considered sacrificial. Once the tap has been made, a plug valve shall be installed for operation / isolation, and the tapping valve shall be locked in the fully open position.

D. TAPPING SLEEVES AND CROSSES

1. Tapping sleeves and tapping crosses used to make "wet" taps into existing mains shall be provided and installed at locations as shown on the Construction Drawings.
2. For size on size connections, tapping sleeves and crosses shall be mechanical joint split cast iron units, internally coated per Appendix B, and rated for 150 psi working pressure in accordance with ANSI/AWWA C110/A21.10.
3. For less than size on size connections, tapping sleeves shall be fabricated steel units with a coating per Appendix B and pressure rated to 150 psig.
4. The Contractor shall determine the outside diameter of the existing main before ordering the sleeve.
5. Tapping sleeves shall be of the mechanical joint type with outlet flange conforming to

ANSI B16.1, class 125 standard.

E. SERVICE SADDLES

1. Service saddles as a minimum will be supplied with double tie straps and shall be fabricated of ductile iron and be suitable for either wet or dry installation. The sealing gasket shall be the "O-Ring" type suitable for the applicable service. Tie straps and bolts shall be a corrosion resistant alloy steel.
2. Service saddles shall be as approved in Appendix B.

F. AIR RELEASE VALVE (ARV) ASSEMBLIES

1. Air release valves shall be located at high elevation points on the pipeline and operate automatically. For actual type of air release valve assembly, the Contractor should refer to the details on the Construction Drawings, and 02081.6, exhibits S-15A and S-15B.
2. Air release valves shall be of the type that will release air from the line when pressurized and keep air from entering the line when not pressurized.
3. The air release valve shall have a 2-inch inlet, 316 stainless steel ball valve, saddle and 316 stainless steel pipe and fittings.
4. Valves, fittings, and piping shall be rated for a minimum working pressure of 150 psi.
5. The inner bore of the air release valve shall be Teflon lined.

G. VALVE BOXES

1. The valve boxes shall be cast iron; adjustable to fit the depth of earth cover over the valve; and designed to prevent the transmission of surface loads directly to the valve or piping. See 02081.6, exhibit 12A.
2. Valve boxes shall have an interior diameter of not less than 5-inches.
3. Valve box extensions shall be installed to reserve a minimum of 50% (1/2) of the adjustment for the future extension. Extension sections shall be cast iron only.
4. The valve boxes shall be provided with covers marked "SEWER," painted green, and shall be so constructed as to prevent tipping or rattling. See 02081.6, exhibits S-12A and S-13.
5. The protective concrete collar ring shall be constructed of Type I (3000 psi) concrete. See 02081.6, exhibit S-13 & S-14.

PART 4 - CONSTRUCTION

02081.2 – 4.1 WORK AT HIGHWAY OR RAILROAD CROSSINGS

The 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.

02081.2 – 4.2 PRECONSTRUCTION PIPE INSPECTION/CERTIFICATION

- A. 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.
 1. For County Contracted projects, the Contractor shall submit these certificates to the Project Manager prior to installation of the pipe materials.
 2. For developer projects, the Contractor shall submit these certificates to the WRS Inspection Group prior to the installation of the pipe materials.
- B. Joints or fittings that do not conform to these specifications will be rejected and must be removed immediately by the Contractor.

- C. 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.
- D. 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.

02081.2 – 4.3 INSTALLATION

- A. The provisions set forth herein shall be applicable to all underground wastewater piping installations.
- B. It shall be the Contractor's and/or 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.
- C. 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.
- D. See 02081.5, exhibit S-7 for Jack and Bore details and exhibit S-8 for Ditch Crossing details.
- E. Directional Drill: Where open cut is not practical, directional drilling complying with the requirements of the Utility Accommodation Guide and specification 02072 may be used. All directional drill locations shall be indicated on the Construction drawings, and approval from WRS is required prior to starting construction.
 - 1. Horizontal directional drilling shall use Certalock PVC, or for casing, HDPE.
 - 2. As an alternate to Certalok PVC, ductile iron or fusible PVC may be used with prior WRS approval.
- F. No pipe shall be laid when the trench conditions or the weather is unsuitable for such work,-
- G. 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.
- H. Electronically detectable tape shall be installed in trenches above all PVC force main piping approximately 18 inches above the pipe. The tape shall be continuous between valves and secured to each valve. The tape shall be at least 4.5 mils thick, 2 inches minimum width and made with an aluminum material sandwiched between 2 layers of polyethylene. It shall have imprinted in permanent black ink with 1-inch letters "CAUTION FORCE MAIN BURIED BELOW" on green background. See Appendix B for approved products.
- I. All PVC pipe shall be installed with 2 insulated 10 gauge copper locating wires (when directional drill installation has been approved, use 6 gauge wires) attached at 10:00 and 2:00.
 - 1. Wires shall be attached using minimum 2" wide duct tape. Tape shall be at every joint and 4 to 5 feet spacing.
 - 2. Locating wires shall terminate 4 or more inches above the concrete valve pad and shall be folded back inside a 3" PVC access pipe (see 02081.6 Exhibit S-12A). A continuity test shall be performed by the contractor in the presence of the County inspector.
- J. Excavation, trenching and backfilling shall be in accordance with the requirements of the applicable portions of these specifications. In addition, all underground facility installations shall comply with the requirements of section 5.4 of the Utility Accommodation Guide.

02081.2 - 4.4 TRENCH EXCAVATION

- A. All excavations shall be open cut, with banks of trenches kept as nearly vertical as possible and wide enough to allow approximately 8 inches clearance on each side of the pipe.
- B. The trench floor shall provide a uniform bearing for each full length of pipe section. Excavate bell holes after trench has been graded.
- C. Perform all excavations of whatever substance encountered to the depths shown or indicated on plans.
- D. In the event unsuitable or unstable soil is encountered, remove it and replace with sand, gravel, #57 limestone (or combination thereof) or other material as approved by the Project Manager or Engineer.
- E. 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.
- F. Protection of Trees: Trenching shall not take place within the root zone of trees with a trunk diameter of 6-inches or larger. The root zone shall be defined as the greater of 1) the drip line of the tree or 2) a circular zone extending outward from the base of the tree a distance equivalent to $\frac{1}{2}$ - foot for every inch of trunk diameter as measured 4 $\frac{1}{2}$ feet above natural grade (see 02081.6 exhibit S-9). Exotic nuisance species, such as Brazilian Pepper and Melaleuca, are exempt from this protection.

02081.2 - 4.5 HANDLING AND CUTTING PIPE

- A. 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.
- B. 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.
- C. 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 WRS, 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.
- D. 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.

02081.2 - 4.6 PIPE LAYING

- A. Pipe shall be constructed of the materials specified and as shown on the drawings.
- B. 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.
- C. 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.

D. GRADIENT

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.
 2. Any pipe which has its grade or joint disturbed after lying shall be taken up and re-laid.
- E. Pipe Joint Deflection: Whenever it is desirable to deflect pipe, the amount of deflection for ductile iron pipe shall not exceed 75% of the maximum limits as shown in AWWA C600. Deflection of PVC pipe shall not exceed 75% of the manufacturer's recommendations.
- F. 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.
- G. Joint Compounds: Sulfur based joint compounds shall not be used.
- H. Subaqueous Crossings: Piping for subaqueous crossings for force mains shall be placed in position with the use of non-metallic canvas slings. Metal chains are not permitted to be used to lower piping into the subaqueous trench.
- I. 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.
- J. Installation of PVC pipe and fittings shall be in accordance with the installation requirements established by the manufacturer and ASTM D2321.

02081.2 - 4.7 INSTALLING JOINTS

- A. The joints of all pipelines shall be 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.
- B. Pipe joints shall be bolted or otherwise restrained, where shown on the Construction drawings, or where in the opinion of the Design Engineer, settlement or vibration is likely to occur.
- C. Mechanical Joints: All types of mechanical joint pipes shall be laid and jointed in full conformance with manufacturer's recommendations. Torque wrenches set as specified in ANSI/AWWA C111/A21.11, shall be used; or spanner type wrenches not longer than specified therein may be used with the permission of the County.
- D. Push-On Joints: Push-on joints shall be made in strict compliance with the manufacturer's recommendations. Lubricant shall be an inert, non-toxic, water soluble compound.
- E. Joint Compounds: Sulfur based joint compounds shall not be used.
- F. Ball and socket joints shall be installed in strict accordance with the manufacturer's instructions.
- G. Restrained Joints shall be provided at all changes in direction, and size changes, of all mains. All pipe and fitting joints shall be restrained as shown on the Construction Drawings, and in accordance with manufacturer's recommendations.

02081.2 – 4.8 INSTALLING APPURTENANCES

A. VALVES AND VALVE BOXES

1. Valves shall be carefully inspected, opened wide and then tightly closed and the various nuts and bolts shall be tested for tightness, on site, prior to installation.

- a. Special care shall be taken to prevent any foreign matter from becoming lodged in the valve seat.
 - b. Any valve that does not operate correctly shall be immediately removed and replaced by the Contractor.
2. Valve Boxes: Valve boxes shall be carefully centered over the operating nuts of the valves so as to permit a valve key to be fitted easily to the operating nut.
- a. Valve boxes shall be set to conform to the level of the finished surface and held in position by a ring of concrete placed under the support flange. See 02081.6, exhibit 12A.
 - b. The valve box shall not transmit surface loads to the pipe or valve.
 - c. Care shall be taken to prevent earth and other material from entering the valve box.
 - d. Any valve box which is out of alignment or whose top does not conform to the finished ground surface shall be dug out and reset.
 - e. Before final acceptance of the work, all valve boxes shall be adjusted to finish grade and shall reserve 50% of their total adjustment for future extension.
 - f. The operating nut should not exceed 36 inches below finished grade. However, if conditions require the operating nut to exceed 36 inches, then an extension, mechanically attached to the valve, shall be added, and the top of the extension shall not exceed 12 inches below finished grade. See 02081.6, exhibit S- 12B.
 - g. The valve boxes shall be provided with covers marked "SEWER" and shall be so constructed as to prevent tipping or rattling. The valves shall be identified with a bronze disc embedded in concrete. See 02081.6, exhibits. S-13 and S-14.
- B. AIR RELEASE VALVES:
1. Air release valves shall be installed at locations as indicated on the Construction Drawings.
 2. The locations indicated are approximate. The actual placement of the air release valves shall be determined in the field and shall be located at the high points as established during installation of the force main and as approved by Water Resource Services.
 3. The air release valves shall be installed in a shallow manhole, as shown in exhibit S-15A for a standard assembly and exhibit S-15B for an offset assembly.
 4. The Contractor shall submit for approval a profile of the force main in the vicinity of all high points indicated. The profile shall extend a minimum of 200 linear feet to each side of the expected high point(s) of the force main. Elevations shall be submitted of the high point and the top of the pipe at 50 foot intervals within the 400 foot area described above
- C. SLEEVES
1. Sleeves shall be constructed in accordance with details shown on the Construction Drawings.
 2. Sleeves shall be constructed when:
 - a. Indicated on Construction Drawings.
 - b. The Engineer shall order the line sleeved.
 - c. Vertical and horizontal clearances, complying with part 2.5 herein, cannot be maintained between pipelines.

02081.2 - 4.9 BACKFILL/COMPACTION

- A. 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.
- B. Backfill 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.

- C. 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 below shall be considered the minimum allowable.
- D. Backfilling Procedures: The backfilling procedures outlined below shall be for water mains and related structures. The backfilling shall be done in three stages as follows:
 - 1. 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 6-inch layers and thoroughly tamped over the entire surface.
 - 2. 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 twice the outside diameter of the pipe. Material to be placed in 6-inch layers (loose thickness).
 - 3. 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.
- E. Compaction Density: The trench backfill density for all stages shall be as provided below:
 - 1. From right-of-way line to right-of-way line, 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 a minus 2% tolerance.
 - 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 a minus 2% tolerance.
- F. COMPACTION TEST REQUIREMENTS
 - 1. Compaction test results shall be submitted for all work in existing or proposed right-of-ways and easements.
 - 2. Results of compaction tests must meet minimum requirements prior to proceeding with the next stage of the work.
 - 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. 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.
 - 5. The Contractor shall employ an independent testing laboratory, acceptable to the County and pay for all required tests.
 - 6. The laboratory shall submit one copy of the certified test reports, after testing in each phase, to the Construction Services Section in the Planning and Growth Management Department, or the County Project Manager (as applicable), for approval.
 - 7. In the second stage of backfilling, density tests shall be made every one (1) foot vertically, staggered every 500 feet (minimum) horizontally. There shall be a minimum of one test between structures.

02081.1 - 4.10 FLUSHING AND CLEANING

- A. All mains shall be cleaned and flushed to remove all sand and other foreign matter.
 - 1. The Contractor shall be responsible for developing a flushing plan to be submitted to the County Engineer for approval with the shop drawings.
 - 2. The Contractor shall dispose of all water used for flushing without causing a nuisance or property damage.
 - 3. Any permits required for the disposal of flushing water shall be the responsibility of the Contractor.
- B. Flushing water used by the Contractor shall be taken from an approved metered source. -Flushing water shall be at Contractor's expense.
- C. Pipeline shall be cleaned with a "pig", of an appropriate material for the pipeline to be cleaned, so as not to damage the interior lining of the pipeline. Contractor shall be responsible to install and remove appropriate connections to accomplish the required pipeline "pigging".
- D. Temporary plugs or caps shall be installed on new mains until the pressure and leakage tests are completed. Upon satisfactory completion of the tests the caps or plugs shall be removed and the connections made to the existing water mains.

02081.2 – 4.11 HYDROSTATIC AND LEAKAGE TEST

- A. The force main shall be tested in sections between valves. The total length of pipe for any single test shall be 2,000 feet. Testing shall be done immediately after installation and backfilling has been completed.
- B. The piping shall be tested in sections, thereby, testing each valve for secure closure.
- C. The mains shall be tested in accordance with, the latest revision of AWWA C600 (for Ductile Iron) and C605 (for PVC) under an average hydrostatic pressure of not less than 150 psig, using a 300 psig gage, for a minimum of 2 hours. Pressure shall be maintained until all sections under testing have been checked for evidence of leakage.
- D. While the system is being filled with water, air shall be carefully and completely exhausted. If permanent air vents are not located at all the high points, the Contractor shall install corporation stops or fittings and valves at such points so the air can be expelled as the pipe system is slowly filled.
- E. The test pressure shall not vary by more than ± 5 for the duration of the test. Rate of loss shall not exceed that specified in sections M or N as listed below. Visible leaks shall be corrected regardless of total leakage shown by test.
- F. All pumps, gauges and measuring devices shall be furnished, installed and operated by the Contractor and all such equipment and devices and their installation shall be approved by the County Inspector.
- G. Water for testing and flushing shall be potable and/or reclaimed water provided by the Contractor, at no cost to the County, from a source approved by the County. Flow velocity during line filling should not exceed 2 fps.
- H. The quantity of water used for testing, which shall be compared to the allowable quantity, shall be measured by pumping from a calibrated container, again approved by the County Inspector.
- I. All restrained sections of the buried main shall be completely backfilled before such sections are tested.
- J. All pressure and leakage testing shall be done in the presence of the County Inspector and the Engineer of Record or his designated representative.
- K. When leakage occurs in excess of the specified amount, defective pipe, pipe joints or other appurtenances shall be located and repaired at the expense of the contractor. If the defective

portions cannot be located, the contractor, at his own expense, shall remove and reconstruct as much of the original work as necessary to obtain a force main within the allowable leakage limits upon retesting.

- L. If the Contractor elects to perform hydrostatic testing against valves in an existing distribution system, he does so at his own risk and will bear the cost of any damage to the existing valve, piping system, private or public property, or the new pipeline under test.
- M. ALLOWABLE LIMITS FOR LEAKAGE IN DUCTILE IRON PIPE
 - 1. The hydrostatic pressure test shall be performed as specified herein and no installation, or section thereof, will be acceptable until the leakage is less than the number of gallons per hour as determined by the formula:

$$L = \frac{SD(P)^{1/2}}{148,000}$$

in which:

- L = Testing Allowance (makeup water), in gallons per hour
- S = Length of pipe in feet being tested
- D = Nominal diameter of pipe, in inches
- P = Average test pressure during the test, in psig

- 2. Water shall be supplied to the main during the test period as required to maintain the test pressure as specified.
 - 3. The quantity used, which shall be compared to the above allowable quantity, shall be measured by pumping from a calibrated container. A 5/8-inch meter installed on the discharge side of the pump may be used to measure the leakage for large mains when approved by the County Inspector All hydrostatic leakage tests shall be recorded on the form(s) attached in part 6.
- N. ALLOWABLE LIMITS FOR LEAKAGE IN PVC PIPE:
 - 1. The hydrostatic pressure test shall be performed as specified herein and no installation or section thereof, will be acceptable until the leakage is less than the number of gallons per hour as determined by the formula:

$$(1) \quad Q = \frac{LD(P)^{1/2}}{148,000} \qquad \text{OR} \qquad (2) \quad Q = \frac{ND(P)^{1/2}}{7,400}$$

in which:

- Q = Quantity of makeup water, in gallons per hour
- N = Number of joints in the tested line (pipe & fittings)
- L = Length of pipe section being tested, in feet
- D = Nominal diameter of pipe in inches.
- P = Average test pressure during the test, in psig

NOTE: Equation (2) is for gasketed pipe in 20 ft. lengths.

- 2. Water shall be supplied to the main during the test period as required to maintain the test pressure as specified. The quantity used, which shall be compared to the above allowable quantity, shall be measured by pumping from a calibrated container. A 5/8-inch meter installed on the discharge side of the pump may be used to measure the leakage for large mains when approved by the County Inspector All hydrostatic leakage tests shall be recorded on the form(s) attached in part 6 :

02081.2 – 4.12 CONNECTIONS TO EXISTING SYSTEM

- A. The Contractor shall supply a connection and procedure schedule to the County, for approval, two (2) weeks prior to the proposed connection date. After approval of the schedule, the County will be responsible for shutting down the pump stations or closing valves, as applicable, while the Contractor makes the required connection as quickly as possible.
- B. The Contractor shall provide, operate, and maintain all wastewater flow by-passes required to complete the project. Coordinate and obtain procedure approval from the Engineer and Public Utility representative at least 48 hours prior to implementation.
- C. All connections to existing mains shall be made under the direction supervision of HCWRS after the Contractor has coordinated with and received approval from the County (approval shall be obtained through PGMD, or the County Project Manager, as applicable).
- D. Valves on existing mains will be operated by HCWRS personnel or under their direct supervision.
- E. TAPPING A FORCE MAIN
 1. The contractor shall submit a request to the Service Availability Team, Customer Service Section of HCWRS to schedule a tap, and pay the appropriate tapping fee. The request shall be made a minimum of 48 hours prior to the proposed tie-in.
 2. The Contractor shall furnish, install and pressure test the tapping sleeve and valves to the existing force main.
 3. For all taps up through 12 inches, HCWRS personnel will furnish the necessary tapping machine and tools, and will perform the tap.
 4. For taps larger than 12 inches, the contractor shall furnish the tapping machine and tools, and shall perform the tap under HCWRS supervision. All taps shall be witnessed by the County Inspector.
 5. Prior to the tap the contractor shall assemble all materials, tools, equipment, labor and supervision necessary to make the connection.
 6. The Contractor shall excavate and maintain a dry and safe working pit of sufficient size to facilitate the inspection and tapping of the line.
 7. The Contractor will locate the main, and shall pressure test the tapping sleeve and valve to 150 psig, or 10 psig above the pressure in the main being tapped, whichever is greater.
 8. The Contractor will maintain the pressure on the sleeve for 10 minutes at zero (0) pressure loss.
 9. When the Contractor is required to make the tap, they shall make the tap while the main is in service using standard tapping techniques as approved by the County
 - a. The force main shall be tapped in such a manner that the operation of the main in service is not disturbed.
 - b. The Contractor shall obtain the approval of Water Resource Services for methodology and subcontractor personnel prior to initiating any tap.
 10. The Contractor shall be responsible for properly backfilling the work pit after the work is completed.
 11. The tapping valve, isolation plug valve, and sleeve become the property of the County upon successful completion of the tap.

PART 5 – WASTEWATER PEAKING FACTORS

AVERAGE FLOW (MGD)	PEAK FACTOR
0 - .10	3.00
.101 - .20	2.95
.201 - .30	2.90
.301 - .40	2.85
.401 - .50	2.80
.501 - .60	2.75
.601 - .70	2.70
.701 - .80	2.65
.801 - .90	2.60
.901 - 1.0	2.55
1.01 - 2.0	2.50
2.01 - 4.0	2.25
>4.0	2.00

**ALLOWABLE LEAKAGE TEST REPORT
FOR
DUCTILE IRON PIPE**

PROJECT NAME: _____ PROJ. NO.: _____

ENGINEER OF RECORD NAME: _____

COMPANY : _____

CONTRACTOR REPRESENTATIVE NAME: _____

COMPANY NAME: _____

SERVICE REQUEST NO.: _____ DATE: _____

INSPECTOR: _____

_____ WATER PRESSURE TEST _____ FORCEMAIN PRESSURE TEST

CALCULATIONS BASED ON AWWA C600

$$L = \frac{S D (P)^{1/2}}{148,000}$$

WHERE: L = TESTING ALLOWANCE (MAKEUP WATER) IN GALS. PER HOUR.
 S = LENGTH OF PIPE TESTED, IN FEET
 D = NOMINAL DIAMETER OF PIPE IN INCHES
 P = AVERAGE TEST PRESSURE (PSIG)

CALCULATIONS:

$$L = \left[\frac{\quad}{133,200} \right] \left[\frac{\quad}{148,000} \right] (\quad)^{1/2} = \quad \text{GALS./HR. ALLOWED}$$
$$\text{GALS.HR. X 2 HR.} = \quad \text{GALS. ALLOWED LOST}$$

FIELD MEASUREMENTS:

START TEST @ _____ PRESSURE = _____ # READING = _____

FINISH TEST @ _____ PRESSURE = _____ # READING = _____

LOSS = _____ # GALLONS = _____

PEOPLE PRESENT:

TEST RESULTS AND COMMENTS:

**ALLOWABLE LEAKAGE TEST REPORT
FOR
POLYVINYL CHLORIDE PIPE**

PROJECT NAME: _____ PROJ. NO.: _____

ENGINEER OF RECORD NAME: _____

COMPANY : _____

CONTRACTOR REPRESENTATIVE NAME: _____

COMPANY NAME: _____

SERVICE REQUEST NO.: _____ DATE: _____

INSPECTOR: _____

_____ WATER PRESSURE TEST _____ FORCEMAIN PRESSURE TEST

CALCULATION (1) BASED ON AWWA C605
CALCULATION (2) BASED ON UNI-BELL EQUATION 99 FOR GASKETED PIPE IN 20 FT LENGTHS.

$$(1) \quad Q = \frac{L D (P)^{1/2}}{148,000}$$

$$(2) \quad Q = \frac{N D (P)^{1/2}}{7,400}$$

WHERE: Q = ALLOWABLE LEAKAGE IN GALS. PER HOUR.
 L = LENGTH OF PIPE BEING TESTED, IN FEET
 N = NUMBER OF JOINTS IN THE TESTED LINE (PIPE AND FITTINGS)
 D = NOMINAL DIAMETER OF PIPE IN INCHES
 P = AVERAGE TEST PRESSURE (PSIG)

CALCULATIONS:

Q = $\frac{[\quad] [\quad] (\quad)^{1/2}}{148,000}$ = _____ GALS./HR. ALLOWED
GALS.HR. X 2 HR. = _____ GALS. ALLOWED LOST

FIELD MEASUREMENTS:

START TEST @ _____ PRESSURE = _____ # READING = _____
FINISH TEST @ _____ PRESSURE = _____ # READING = _____
LOSS = _____ # GALLON = _____

PEOPLE PRESENT:

TEST RESULTS AND COMMENTS:

END OF SPECIFICATION