

SECTION 33 31 20
HIGH DENSITY POLYETHYLENE (HDPE) SANITARY SEWER PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes High Density Polyethylene (HDPE) pipe and fittings from 4-inch through 12-inch for sanitary sewer applications including force mains. This section only applies to force mains with an operating pressure below 200 pounds per square inch (psi).
- B. Charlotte Water does not allow HDPE pipe for gravity sewer installed by open cut. Charlotte Water allows HDPE pipe for sewer rehabilitation projects installed by pipe bursting. HDPE specifications for pipe bursting are located in Chapter XX, Sanitary Sewer Rehabilitation Specifications, of the Charlotte Water Design Manual.
- C. Refer to Chapter XVII of the Charlotte Water Design Manual for force main valve requirements.

1.2 REFERENCE STANDARDS

- A. Reference Standards
 - 1. Reference standards cited in this Specification refer to the current reference standard published at the time of the latest revision date logged at the end of this Specification, unless a date is specifically cited.
 - 2. In the event of a conflict, the most stringent requirements prevail. Submit conflicts to the Owner in writing prior to purchase of materials.
- B. Charlotte Water Design Manual
 - 1. Chapter XVII – Pump Stations and Force Main Specifications and Policies
 - 2. Chapter XX – Standard Sanitary Sewer Rehabilitation Specifications
- C. ANSI/AWWA www.awwa.org
 - 1. AWWA M55 Manual of Water Supply Practices, PE Pipe–Design and Installation
 - 2. ANSI/AWWA C111/A21.11-12 Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
 - 3. ANSI/AWWA C901-08 Polyethylene (PE) Pressure Pipe and Tubing, ½ In. (13 mm) Through 3 In. (76 mm) for Water Service
 - 4. ANSI/AWWA C906-07 Polyethylene (PE) Pressure Pipe and Fittings, 4 In. (100 mm) Through 63 In. (1,600 mm), for Water Distribution and Transmission
- D. Plastics Pipe Institute, PPI www.plasticpipe.org
 - 1. PPI Handbook of Polyethylene Pipe – 2009 (2nd Edition)
 - 2. PPI TR-33 Generic Butt Fusion Joining Procedure for Polyethylene Gas Pipe
 - 3. PPI TR-41 Generic Saddle Fusion Joining Procedure for Polyethylene Gas Piping
 - 4. PPI TN-42 Recommended Minimum Training Guidelines for PE Pipe Butt Fusion Joining Operators for Municipal and Industrial Projects (2009)

E. ASTM www.astm.org

1. ASTM D 2239 Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Controlled Inside Diameter
2. ASTM D 2683 Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing
3. ASTM D 2737 Standard Specification for Polyethylene (PE) Plastic Tubing
4. ASTM D 2774 Standard Practice for Underground Installation of Thermoplastic Pressure Piping
5. ASTM D 3261 Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
6. ASTM D 3350 Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
7. ASTM F 585 Standard Guide for Insertion of Flexible Polyethylene Pipe Into Existing Sewers
8. ASTM F 714 Standard Specification for Polyethylene (PE) Plastic Pipe (SDR- PR) Based on Outside Diameter
9. ASTM F 905 Standard Practice for Qualification of Polyethylene Saddle-Fused Joints
10. ASTM F 1055 Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing
11. ASTM F 1290 Standard Practice for Electrofusion Joining Polyolefin Pipe and Fittings
12. ASTM F 1412 Standard Specification for Polyolefin Pipe and Fittings for Corrosive Waste Drainage Systems
13. ASTM F 2164 Standard Practice for Field Leak Testing of Polyethylene (PE) Pressure Piping Systems Using Hydrostatic Pressure
14. ASTM F 2206 Standard Specification for Fabricated Fittings of Butt-Fused Polyethylene (PE) Plastic Pipe, Fittings, Sheet Stock, Plate Stock, or Block Stock
15. ASTM F 2620 Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings

1.3 SYSTEM DESIGN PARAMETERS

A. Surge Pressure

1. Per AWWA C906, the repetitive surge pressure allowance is one half the pressure class of the pipe, and the occasional surge over pressure allowance is equal to the pressure class of the pipe. Allowable Total Pressure during Recurring Surge conditions equals 1.5 times the pipe’s pressure class. Allowable Total Pressure during Occasional Surge conditions equals 2.0 times the pipe’s pressure class.
2. Table 1 gives the Pressure Class per AWWA C906, Pressure Rating and Allowable Total Pressure During Recurring and Occasional Surge for PE4710 pipe at 80°F or less.

Pipe Dimension Ratio (DR)	Pressure Class	Pressure Rating	Allowable Total Pressure During Recurring Surge	Allowable Total Pressure During Occasional Surge
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DR 11	200 psi	200 psi	300 psi	400 psi
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1.4 SUBMITTALS

A. Requirements

1. Submittals shall be in accordance with requirements in Submittals Section.
2. All submittals shall be approved by the Engineer or the City prior to delivery.
3. The Contractor shall submit to the Owner, within ten days after receipt of Notice to Proceed, a list of materials to be furnished, the names of the suppliers, and the appropriate shop drawings for all polyethylene pipe and fittings.
4. The Contractor shall submit the pipe manufacturer's certification of compliance with the applicable sections of the Specifications. This certification shall be in the form of a written document from the manufacturer attesting to the manufacturing process meeting the standards.
5. The Contractor shall submit shop drawings showing installation method and the proposed method and specialized equipment to be used.
6. Manufacturers recommended fusion procedures for the products.

B. Provide Product Data

1. Manufacturer
2. Dimension Ratio
3. Joint Types
4. Restraint, if required in Contract Documents
 - a. Retainer glands
 - b. Thrust harnesses
 - c. Any other means of restraint

C. Installer Qualifications

1. Provide certifications meeting requirements of section 3.1 for each installer. Keep certifications on project site available to Owner, Engineer, and Inspector.

D. Provide Internal Stiffeners Data

E. Provide Mechanical Joint Adapters Data

F. Data Logger Records

1. Provide electronic data logger record to the inspector daily or on request of inspector.
2. Fusion Reports shall report manufacturer, component, component fusion-jointing parameters, assembly operation and joint identification, per ISO 12176-4, and the following fusion-jointing operation data:
 - a. Temp-Compensated Fusion Time & Actual Fusion Time
 - b. Resistance before & after fusion
 - c. Hi and Low output voltage & output current during fusion
 - d. Total Amp-Hours applied to fitting
 - e. Input voltage and frequency before fusion

- f. High and Low input voltage and frequency during fusion
 - g. Input waveform
 - h. GPS position and quality
 - i. Ambient temperature
 - j. Heating iron face temperatures
 - k. Fusion pressure
 - l. Graphic representation of the fusion cycle.
3. Report shall comply with ISO 12176-2 requirements for traceability databases.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Delivery, Storage, and Handling Requirements

1. Handle the pipe in accordance with the PPI Handbook of Polyethylene Pipe (2nd Edition), Chapter 2 using approved strapping and equipment rated for the loads encountered. Do not use chains, wire rope, forklifts or other methods or equipment that may gouge or damage the pipe or endanger persons or property.
2. Follow manufacturer's recommendations for delivery, storage, and handling.
3. No stacking of pipe is allowed, unless within a fenced contained workspace. Pipe stacking is to be in compliance with AWWA Manual of Practice M55 Table 7-1.
4. If any gouges, scrapes, or other damage to the pipe results in loss of 10% of the pipe wall thickness, cut out that section or do not use. Damages resulting from improper delivery, storage, or handling are the responsibility of the Contractor, and no additional payment shall be allowed by the Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Only the pipe manufacturers as listed below are allowed. Other manufacturers may be considered as equals on a project basis.
 1. Performance Pipe
 2. Georg Fischer
 3. JM Eagle
 4. Driscoplex
 5. WL Plastics
- B. Only the electrofusion fittings manufacturers as listed below are allowed. Other manufacturers may be considered as equals on a project basis.
 1. Agru America
 2. Georg Fischer Central Plastics
 3. Integrity Fusion Products
 4. IPEX, Inc.

5. M.T. Deason Company
 6. Nupi Americas
 7. Plasson, USA
 8. Strongbridge-Tega
- C. Only the butt fusion fittings manufacturers as listed below are allowed. Other manufacturers may be considered as equals on a project basis.
1. ISCO
 2. IPEX
 3. Georg Fisher
- D. Only the fusion equipment manufacturers as listed below are allowed. Other manufacturers may be considered as equals on a project basis.
1. McElroy
- E. Any product that is not listed on the Standard Products List is considered a substitution and shall be submitted in accordance with Substitution Request Section of the Project Manual.

2.2 HDPE PIPE

- A. High Density Polyethylene (HDPE) pipe and fittings shall meet the requirements of AWWA C906.
- B. HDPE must meet the following minimum Dimension Ratio:

Diameter (inch)	Min Dimension Ratio
4 through 12	DR 11

- C. The outside diameter of the pipe shall be based upon the **Iron Pipe Size (IPS)** sizing system.
- D. Polyethylene pipe shall be made from HDPE material having a material designation code of PE4710 or higher.
- E. The material shall meet the requirements of ASTM D 3350 and shall have a minimum cell classification of PE445474C.
- F. Pressure Pipe shall be approved by the Underwriter's Laboratory (UL) or Factory Mutual (FM).
- G. Pipe Markings
 1. Meet the minimum requirements of AWWA C906. Minimum pipe markings shall be as follows:
 - a. Manufacturer's Name or Trademark and production record
 - b. Nominal pipe size
 - c. IPS
 - d. Dimension Ratio
 - e. AWWA C906
 - f. Seal of testing agency that verified the suitability of the pipe

- g. Resin type (PE4710)
- 2. Color identification to identify pipe service is required.
 - a. Stripes or colored exterior pipe product shall be green for wastewater/sewage,
 - b. Pipe interior shall be gray for visual inspection.
 - c. Permanent identification of piping shall be provided by co-extruding multiple equally spaced color stripes into the pipe outside surface or by solid colored pipe shell.
 - d. The striping material shall be the same material as the pipe material except for the color.
 - e. Plain Black HDPE Pipe without color code markings may not be used.
- H. Only smooth wall HDPE will be permitted. Charlotte Water does not allow the use of corrugated HDPE for sanitary sewer piping.

2.3 HDPE BUTT FUSION FITTINGS

- A. Butt Fusion Fittings shall be made of HDPE material with a minimum material designation code of PE4710 and with a minimum Cell Classification as required for HDPE Pipe.
- B. Butt Fusion Fittings shall meet the requirements of ASTM D3261. Molded and fabricated fittings shall have a pressure rating equal to or greater than the pipe unless otherwise specified on the plans.
 - 1. Fabricated Fittings shall be Equivalent Dimension Ratio to DR11.
 - 2. Pipe stock used to manufacture fabricated fittings shall meet requirements of AWWA C906 and meet the material designation code of PE4710.
 - 3. Fabricated Fittings typically require a lower DR rating than the pipe to meet or exceed the pipe pressure rating. Calculate the difference for a fabricated fitting based on a published rerating percentage.
 - 4. Fabricated bend and tee fittings shall have a minimum of 3 segments.
 - 5. Fabricated bend fittings over 45 degrees through 90 degrees shall have a minimum of four segments.
 - 6. Field fabricated fittings are not allowed.
- C. All fittings shall meet the requirements of AWWA C906.
- D. Markings for molded fittings shall comply with the requirements of ASTM D 3261.
 - 1. Standard Designation (ASTM D 3261)
 - 2. Manufacturer's name or trademark
 - 3. Material designation (PE4710)
 - 4. Date of manufacture or manufacturing code
 - 5. Size
 - 6. Dimension Ratio (example: DR11)
- E. Fabricated fittings shall be marked in accordance with ASTM F 2206.

1. Standard Designation (ASTM F 2206)
2. Manufacturer's name or trademark
3. Material designation (PE4710)
4. Date of manufacture or manufacturing code
5. Size
6. Equivalent Dimension Ratio

2.4 HDPE ELECTROFUSION FITTINGS

- A. Electrofusion Fittings shall be made of HDPE material with a minimum material designation code of PE 4710 and with a minimum Cell Classification as noted for HDPE pipe.
- B. Electrofusion Fittings shall have a manufacturing standard of ASTM F1055. Fittings shall have a pressure rating equal to the pipe unless otherwise specified on the plans.
- C. All electrofusion fittings shall be suitable for use as pressure conduits, and have nominal burst values of four times the Working Pressure Rating (WPR) of the fitting.
- D. Markings shall be according to ASTM F 1055.
 1. Standard Designation (ASTM F 2206)
 2. Manufacturer's name or trademark
 3. Material designation (PE4710)
 4. Date of manufacture or manufacturing code
 5. Size
 6. Equivalent Dimension Ratio

2.5 FLANGES AND MECHANICAL JOINT ADAPTERS (MJ ADAPTERS)

- A. Flanges and Mechanical Joint Adapters shall have a material designation code of PE4710 or higher and a minimum Cell Classification as noted for HDPE pipe.
- B. Flanged and Mechanical Joint Adapters can be made to ASTM D 3261 or if machined, must meet the requirements of ASTM F 2206.
- C. The outside diameter of Flanges shall be based on Iron Pipe Size (IPS).
- D. The MJ Adapters shall be based on Iron Pipe Size by Ductile Iron Pipe Size (IPS x DIPS).
- E. Flanges and MJ Adapters shall have a pressure rating equal to the pipe unless otherwise specified on the plans.
- F. Markings for molded or machined flange adapters or MJ Adapters shall be per ASTM D 3261.
 1. Manufacturer's name or trademark
 2. Material designation (PE4710)

3. Date of manufacture or manufacturing code
 4. Size
 5. Where recessed marking is used, take care not to reduce the wall thickness below the minimum specified.
- G. Fabricated (including machined) flange adapters shall be per ASTM F 2206.
- H. Metal gland for MJ Adapter may be either AWWWA C110 (heavyweight) or AWWWA C153 (lightweight).
- I. Low alloy steel bolts shall comply with AWWA C 111.4. Bolts, rods, and hex nuts shall be manufactured from 304 stainless steel as per ANSI/ AWWA C111/A21.11.
- J. Van-Stone style, metallic (including stainless steel), convoluted, or flat-plate back-up rings and bolt materials shall follow the guidelines of Plastic Pipe Institute Technical Note # 38, and shall have the bolt-holes and bolt-circles conforming to one of these standards: ASME B-16.5 Class 150, ASME B-16.47 Series A Class 150, ASME B-16.1 Class 125, or AWWA C 207 Class 150 Series B, D, or E.
- K. The back-up ring shall provide a long-term pressure rating equal to or greater than the pressure-class of the pipe with which the flange adapter assembly will be used, and such pressure rating shall be marked on the back-up ring. The back-up ring, bolts, and nuts shall be protected from corrosion by a system such as coal-tar epoxy, galvanization, polyether, or polyester fusion bonded epoxy coatings, anodes, or cathodic protection, as specified by the Engineer.

2.6 MECHANICAL JOINT WEDGE ACTION RESTRAINT

- A. Mechanical Joint wedge action restraint shall only be allowed with specific permission of the Engineer in cases where an MJ Adapter is not feasible.
- B. Mechanical Joint wedge action restraint shall be designed specifically for use on HDPE pipe.
- C. The grip of the serrations shall increase as the hydrostatic pressure increases.
- D. There shall be no additional tool required for installation other than the tools required to install standard sizes of hex nuts from 5/8"-1 1/8". The hex heads, bolts and rods shall be designed to tighten clockwise. The hex heads, bolts and rods shall be manufactured to allow for disassembly and re-installation of the restraint.
- E. The gland halves shall be manufactured of high strength ductile iron in accordance with the ASTM A536 Standard, Grade 65-45-12.
- F. Rods are manufactured from 304 stainless steel and hex nuts are manufactured from 316 stainless steel as per ANSI/ AWWA C111/A21.11.
- G. The restraining gland shall comply with all applicable dimensions of ANSI/AWWA C111/A21.11 and shall be compatible with all bell and spigot (push-on) joint sockets of the standard.
- H. Stiffening insert required.

2.7 PIPELINE MARKERS

- A. Provide markers in accordance with Project Manual.
- B. Detectable Warning Tape - All force mains shall be clearly identified with 6-inch wide green plastic locator tape made specifically for that purpose. The tape shall be marked with black lettering clearly identifying the pipeline as sanitary sewer.
- C. Tracer wire - continuous AWG no. 12 gauge solid copper tracer wire with 30 mil thick green HDPE insulation. Perform conductivity test on the tracer wire at final inspection.
- D. Marker post material shall be high-performance fiberglass composite. Minimum 3-foot above ground. Manufactured by Carsonite or accepted equal.

2.8 STIFFENING INSERT (STIFFENER)

- A. Provide Stiffeners at each MJ adapter and coupling per Standard Details.
- B. Stiffening inserts shall be specially designed for use on the inside of HDPE pipe in conjunction with AWWA C111 mechanical joints.
- C. Provide stainless steel per ASTM 240, type 304 or 316.
- D. Stiffener shall be manufactured within the pipe or MJ adapter by the factory.
- E. Field installed stiffeners may be allowed upon approval of Charlotte Water inspector. Wedge style stiffeners are allowed.
- F. Stiffener length must be sufficient to fully encompass the area of the pipe being restrained.
- G. Inserts must be designed for underground pressurized fluid service and are pressure rated to match the pipe DR pressure rating, derated as appropriate for service temperature. Maximum test pressure limited to pipe rated pressure.
- H. Stiffener design shall prevent movement causing fitting to slide or rotate on the pipe.

2.9 FLEX COUPLING RESTRAINT DEVICE

- A. HDPE flex coupling restraint devices will be rated for minimum of 8,000 pounds of force.
- B. Resin used to manufacture device shall meet requirements of ASTM 3350 with minimum cell classification of 445474C.
- C. Device will include bar code and product label tag.
- D. Device will install by electrofusion.

2.10 WALL ANCHOR

- A. Butt fusion wall anchors, or force restraint collars, shall comply with requirements of DR11, Iron Pipe Size (IPS), minimum cell class 445474C, and meeting this specification's requirements for HDPE pipe except for striping.

PART 3 - EXECUTION

3.1 INSTALLERS

- A. Only formally trained and certified fusion technicians may conduct fusions. Qualification of the fusion technician shall be demonstrated by certification in fusion training within the past year for the type of fusion, and size of the pipe, and on the specific equipment to be used on this project. Provide documentation showing current and up-to-date qualification of training obtained to fuse PE pipe in the appropriate sizes and equipment types for the job.
- B. Training in accordance with ASTM F 6220 for butt fusion.
- C. Training in accordance with ASTM F 1055 for electrofusion.
- D. Fusion joints shall be made by qualified fusion technicians per PPI TN-42.
- E. Qualified technician has documented prior experience in performing HDPE pipe installations, head fusion procedures, and testing methods.

3.2 INSTALLATION

- A. General
 - 1. Install pipe, fittings, specials and appurtenances as specified herein, as specified in AWWA M55 and in accordance with the pipe manufacturer's recommendations with the intention of providing a leak-free system to the Owner.
 - 2. Excavate and backfill trenches in accordance with the Project Manual.
- B. Joining Methods
 - 1. Butt Fusion: The pipe shall be joined by the butt fusion procedure outlined in ASTM F 2620 or PPI TR-33. All fusion joints shall be made in compliance with the pipe or fitting manufacturer's recommendations. Fusion joints shall be made by qualified fusion technicians per PPI TN-42.
 - 2. Saddle fusion: Saddle fusion shall be done in accordance with ASTM F 2620 or TR-41 or the fitting manufacturer's recommendations and PPI TR-41.
 - 3. Electrofusion: Electrofusion joining shall be done in accordance with the manufacturers recommended procedure. Other sources of electrofusion joining information are ASTM F 1290 and PPI TN 34. The process of electrofusion requires an electric source, a transformer, commonly called an electrofusion box that has wire leads, a method to read electronically (by laser) or otherwise input the barcode of the fitting, and a fitting that is compatible with the type of electrofusion box used. The electrofusion box must be capable of reading and storing the input parameters and the fusion results for later download to a record file.
- C. Mechanical:
 - 1. Mechanical connection of HDPE to auxiliary equipment such as valves, pumps, and fittings shall use mechanical joint adapters and other devices in conformance with the PPI Handbook of Polyethylene Pipe, Chapter 9 and AWWA Manual of Practice M55, Chapter 6.

2. Unless specified by the fitting manufacturer, a restraint harness or concrete anchor is recommended with mechanical couplings to prevent pullout.
3. Mechanical coupling shall be made by qualified technicians.

D. Joint Recording

1. Butt Fusion: The butt fusion equipment must be capable of reading and storing the input parameters and the fusion results for later download to a record file.
2. Electrofusion: The electrofusion equipment must be capable of reading and storing the input parameters and the fusion results for later download to a record file.
3. The critical parameters of each fusion joint, as required by the manufacturer and these specifications, shall be recorded by an electronic data logging device. All fusion joint data shall be included in the fusion technician’s joint report.

E. Installation

1. Buried HDPE pipe and fittings shall be installed in accordance with ASTM D2321 or ASTM D2774 for pressure systems and AWWA Manual of Practice M55 Chapter 7.
2. Lay pipe with green stripe within 45-degrees either side of crown, if pipe has green stripe.
3. Pipe embedment - Embedment material shall be fine aggregate defined as:
 - a. Granular and free flowing
 - b. Generally meets or exceeds the limits on deleterious substances per Table 1 for fine aggregate according to ASTM C 33
 - c. Reasonably free of organic material
 - d. Gradation:

<u>Sieve Size</u>	<u>Percent Retained</u>
1 inch	0
3/8 inch	0-10
#40	20-60
#100	95

1. Compact backfill per ASTM D 698 and AASHTO T-99 as modified by NCDOT to 85% of maximum density or 95% maximum density within a road right-of-way. Compact the top 12-inches below the road sub-grade to 100% of maximum density within a road right-of-way.

F. Leak Testing

1. Hydrostatic leakage testing is recommended and shall comply with AWWA C651, ASTM F 2164, ASTM F 1412, AWWA Manual of Practice M55 Chapter 9, and PPI Handbook of Polyethylene Pipe Chapter 2 (2nd Edition). If the test section fails this test, the Contractor shall repair or replace all defective materials and/or workmanship at no additional cost to the Owner.
2. Prior to scheduling a test with the inspector, preform a pre-test to confirm compliance.
3. Contractor shall perform hydrostatic and leakage tests in accordance with North Carolina state requirements.

4. Installed main shall be adequately anchored with a covering of at least 6-inches of initial backfill, if installed by an open trench method. The joints and fittings, particularly flange connections shall be left uncovered for visual leak inspection.
5. Leak tests of HDPE water system shall be conducted in accordance with ASTM F2164. The pipeline should be slowly filled with potable water and all trapped air bled off. The main should undergo a hydrostatic pressure test using pressure at the lowest elevation in the system at 150 psi. The pressure shall be maintained constant for 4-hour period by adding makeup water. After 4-hour period is completed, the pressure shall remain steady within 5% (7.5 psi) of a target 150 psi test pressure for one hour.
6. The total test time should not exceed 8 hours. If the pipeline has to be retested – the pipe must be depressurized and allowed to “relax” for at least 8 hours before the next testing sequence.
7. The pressure shall be maintained constant for 4-hour period by adding makeup water. After 4-hour period is completed, test the pressure at the lowest point.
8. Test pressure for one hour. Pressure should remain steady at 1.5 times the working pressure, but not more than the design pressure of the pipe (e.g. 200 psi for DR 11). Pressure must remain within 5% of a target test pressure for one hour.
9. In fused polyethylene water piping system no leakage shall be present. If leakage is observed at a fusion joint, complete rupture may be imminent. The Contractor shall move all personnel away from the joint and depressurize the main. Leaks, failure, or defective construction shall be promptly repaired by the Contractor at the Contractor’s sole expense.
10. Payment for pressure and leakage testing shall be considered included in the price paid per linear foot for water main installation.
11. Pneumatic (compressed air) leakage testing of HDPE pressure piping is prohibited for safety reasons.

G. Pipe Marker Installation

1. See Standard Detail for placement requirements.
2. Install detectable warning tape. Place the tape directly above the pipe embedment material and minimum 1-foot below the ground surface.
3. Install tracer wire. Place the tracer wire at bottom of the pipe embedment material and do not attach wire to pipe. Perform conductivity test on the tracer wire at final inspection.

3.3 SITE QUALITY CONTROL

A. Sanitary Sewer Pipe

- a. The Contractor shall provide bypass pumping and/or flow diversion in accordance with Project Manual.
- b. Prior to final acceptance and final inspection of the pipe by the Engineer, the Contractor shall flush and clean all parts of the system by removing all accumulated construction debris, rocks, gravel, sand, silt, and other foreign material from the pipe.

END OF SECTION

Revision Log		
DATE	NAME	SUMMARY OF CHANGE