

SECTION 02315**EXCAVATION, BACKFILL AND COMPACTION FOR UTILITIES****PART 1 GENERAL****1.01 Scope of Work**

The work specified in this section consists of furnishing all materials, labor, equipment, and other services as necessary for preparing the site for work, the excavating, preparing the trench for the underground utility to be altered or installed, the backfilling and compaction. The excavation and backfill aspects of the work required for installation of underground utilities shall meet all Department of Transportation (DOT) and all local right-of-way authority requirements.

1.02 Contractor Qualifications

- A. When performing trench excavation, the Contractor is to comply with the Occupational Safety and Health Administration's (OSHA) trench safety standards, 29 C.F.R., s. 1926.650, Subpart P. Submission of a bid and subsequent execution of a contract to perform the work required will serve as certification that all trench excavation will be in compliance with OSHA standards.

1.03 Referenced Standards

- A. American Water Works Association (AWWA) latest edition:
1. AWWA C901 - Polyethylene Pressure Pipe and Tubing, ½ Inch Through 3 Inch for Water Service
 2. AWWA C906 - Polyethylene Pressure Pipe and Fittings, 4 Inch Through 65 Inch for Water Distribution and Transmission
- B. American Society for Testing and Materials (ASTM) latest edition:
1. ASTM D638 – Tensile Method for Tensile Properties of Plastics
 2. ASTM D790 – Test Materials for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
 3. ASTM D2122 – Standard Method of Determining Dimensions of Thermoplastics Pipe and Fittings
 4. ASTM D2239 – Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter
 5. ASTM D2321 – Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
 6. ASTM D2657 – Practice for Heat-Joining of Polyolefin Pipe and Fittings

7. ASTM D2683 – Standard Specification for Socket Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing
8. ASTM D2774 – Standard Practice for Underground Installation of Thermoplastic Pressure Piping
9. ASTM D2837 – Standard Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products
10. ASTM D3035 – Polyethylene (PE) Plastic Pipe (DR-PE) Based on Controlled Outside Diameter
11. ASTM D3261 – Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
12. ASTM D3350-14 – Polyethylene Plastic Pipe and Fittings Material
13. ASTM F412 – Standard Terminology Relating to Plastic Piping Systems
14. ASTM F585 – Standard Guide for Insertion of Flexible Polyethylene Pipe Into Existing Sewers
15. ASTM F714 – Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
16. ASTM F905 – Standard Practice for Qualification of Polyethylene Saddle-Fused Joints
17. ASTM F1055 – Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing
18. ASTM F1056 – Standard Specification for Socket Fusion Tools for Use in Socket Fusion Joining Polyethylene Pipe or Tubing and Fittings
19. ASTM F1290 – Standard Practice for Electrofusion Joining Polyolefin Pipe and Fittings
20. ASTM F2164 – Field Leak Testing of Polyethylene (PE) Pressure Piping Systems Using Hydrostatic Pressure
21. ASTM F2206 – Fabricated Fittings for Butt-Fused Polyethylene Plastic Pipe
22. ASTM F2620 – Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings
23. ASTM F2786 – Standard Practice for Field Leak Testing of Polyethylene (PE) Pressure Piping Systems Using Gaseous Testing Media Under Pressure (Pneumatic Leak Testing)
24. ASTM F3124 – Standard Practice for Data Recording the Procedure used to Produce Heat Butt Fusion Joints
25. ASTM F3183 – Standard Practice for Guided Side Bend Evaluation of Polyethylene Pipe Butt Fusion Joint
26. ASTM F3190 – Standard Practice for Heat Fusion Equipment (HFE) Operator Qualifications on Polyethylene (PE) and Polyamide (PA) Pipe and Fittings

C. Plastics Pipe Institute (PPI) latest edition:

1. The Plastics Pipe Institute Handbook of Polyethylene Pipe
2. PPI TR-3 – Policies and Procedures for Developing Hydrostatic Design Basis, Hydrostatic Design Stresses, Pressure Design Basis, Strength Design

- Basis, Minimum Required Strength Ratings, and Categorized Required Strength for Thermoplastic Piping Materials or Pipe
3. PPI TR-4 – PPI HSB Listing of Hydrostatic Design Basis, Hydrostatic Design Stresses, Pressure Design Basis, Strength Design Basis, Minimum Required Strength Ratings, and Categorized Required Strength for Thermoplastic Piping Materials or Pipe
 4. PPI – TR-33 – Generic Butt Fusion Joining Procedure for Field Joining of Polyethylene Pipe
 5. PPI – TN-34 – Installation Guidelines for Electrofusion Couplings 14” and Larger
 6. PPI – TN-36 – General Guidelines for Connecting HDPE Potable Water Pressure Pipes to DI and PVC Piping Systems
 7. PPI – TN-38 – Bolt Torque for Polyethylene Flanged Joints
 8. PPI – TN-44 – Long Term Resistance of AWWA C906 Polyethylene (PE) Pipe to Potable Water Disinfectants
 9. PPI – TN-45 – Mechanical Couplings for Joining Polyethylene Pipe
 10. PPI – TN-46 – Guidance for Field Hydrostatic Testing of High Density Polyethylene Pressure Pipelines: Owner’s Considerations, Planning, Procedures, and Checklists
 11. PPI – TN-49 – Recommendations for AWWA C901 Service Tubes in Potable Water Applications
 12. PPI – TN-54 – General Guidelines for Squeezing Off Polyethylene Pipe in Water, Oil and Gas Applications
- D. Plastics Pipe Institute Municipal Advisory Board (MAB)
1. MAB Generic Electrofusion Procedure for Field Joining of 12 Inch and Smaller Polyethylene Pipe
 2. MAB Generic Electrofusion Procedure for Field Joining of 14 Inch to 30 Inch Polyethylene Pipe
 3. MAB Model Specifications for PE 4710 Buried Potable Water Service, Distribution and Transmission Pipes and Fittings

1.04 Submittals

- A. Submit pipe catalog information confirming that pipe, fittings, joints, and other materials conform to the requirements of the specifications.
- B. Affirmation that product shipped meets or exceeds the standards set forth in this specification. This shall be in the form of a written document from the manufacturer attesting to the manufacturing process meeting the standards.
- C. Submit manufacturer’s recommended fusion procedures for the products.
- D. Submit traffic control plan for all entrance and exit pits.

- E. Provide as-built documentation. Contractor shall plot as-built conditions on the field drawings, including the location in plan and elevation of the installed pipe, at the completion of each production shift. Include on the drawings pipeline horizontal and vertical data recorded every foot along the pipeline.
- F. Contractor to maintain all testing and quality control documentation and assurance procedures. Contractor to provide the following documents to the Owner:
 - 1. Quality control test reports
 - 2. Fusion reports for each weld as reported by the datalogger
 - 3. Certified laboratory test data for the materials and products to be used in the work shall be submitted to the Owner for approval
 - 4. Results of the quality control tests required during the performance of the work shall be submitted to the Owner within 48 hours of completion
 - 5. An independent testing / inspection firm shall provide the following submittals to Owner:
 - a. A statement attesting that the Contractor's work is in accordance with the requirements of the project documents
 - b. Informal daily "pass" or "fail" reports
 - c. Formal weekly reports including all test logs and comments to include density and moisture content test logs, indicating location of tests by coordinates and elevation
 - d. Upon completion of backfill activities, all density and moisture content test logs and comments compiled and submitted
 - e. Sources and test results of all borrowed materials used for backfill

PART 2 PRODUCTS

2.01 Polyethylene Pipe, Fittings and Accessories

- A. Polyethylene pipe and fittings 4-65 inch diameter shall be in accordance with AWWA C906-15, material designation code of PE4710, all applicable ASTM standards and be listed on the PPI TR-4 HSB Listing of Hydrostatic Design Basis Listed Materials.
- B. Polyethylene pipe ½ - 3 inch diameter for main line piping shall be polyethylene pipe (not tubing) in accordance with AWWA C901, material designation code of PE4710, all applicable ASTM standards and be listed on the PPI TR-4 HSB Listing of Hydrostatic Design Basis Listed Materials.
- C. Butt fusion fittings shall be made of HDPE material with a minimum material designation code of PE4710, all applicable ASTM standards and shall be listed in current versions of PPI TR-4. Molded and fabricated fittings shall have a pressure rating equal to the pipe unless otherwise specified on the project documents. All fittings shall meet the requirements of AWWA C901, C906 and all applicable ASTM standards. Markings for molded fittings shall comply with the requirements

of ASTM D3261. Fabricated fittings shall be marked in accordance with ASTM F2206. Socket fittings shall meet ASTM D2683. Fabricated fittings shall be manufactured using a DataLogger to record fusion time, pressure and temperature, and shall be marked with a unique joint identifier that corresponds to the joint report. A graphic representation of the time and pressure data for all fusion joints made producing fittings shall be maintained for a minimum of five years as part of quality control and will be available upon request of owner. Qualification of the fusion technician shall be demonstrated by evidence of fusion training within the past two years on the equipment to be utilized on this project in accordance with ASTM F2620.

- D. Electrofusion fittings shall be made of HDPE material with a minimum material designation code of PE4710 and meet ASTM F1055. Electrofusion fittings shall have a pressure rating equal to the pipe unless otherwise specified on the project documents. All electrofusion fittings shall be suitable for use as pressure conduits and have nominal burst values of four times the working pressure rating of the fitting. Marking of electrofusion fittings shall comply with the requirements of ASTM F1055. All electrofusion fittings shall be properly stored in compliance with the manufacturer's recommendation.

- E. If saddle fusion is used to fuse branch saddles, tapping tees and other HDPE fittings onto the wall of the main pipe, it shall be done in accordance with ASTM F2620 or PPI TR-41 or the fitting manufacturer's recommendations. Saddle fusion joints shall be made by qualified fusion technicians. Qualification of the fusion technician shall be demonstrated by evidence of fusion training within the past two years on the equipment to be utilized on this project in accordance with ASTM F3190.

- F. If socket fusion is used to fuse branch saddles, tapping tees and other HDPE fittings onto the wall of the main pipe, it shall be done in accordance with ASTM D2683 or the fitting manufacturer's recommendations. Socket fusion joints shall be made by qualified fusion technicians. Qualification of the fusion technician shall be demonstrated by evidence of fusion training within the past two years on the equipment to be utilized on this project in accordance with ASTM F3190. All equipment used for socket fusion should comply with ASTM F1056 and manufacturer's recommendations.

- G. Flanges and Mechanical Joint Adapters (MJ) shall have a minimum material designation code of PE4710 and meet all applicable AWWA and ASTM standards. Flanged and MJ adapters can be made to ASTM D3261 or machined in compliance with ASTM F2206. Flanges and MJ adapters shall have a pressure rating equal to the pipe unless otherwise specified on the plans. Markings for molded or machined flange adapters or MJ adapters shall be per ASTM D3261. Fabricated (including machined) flange adapters shall be marked per ASTM F2206. Installation of all Flanged adapters shall follow the guidelines of the Plastics Pipe Institute TN-38.

- H. Glands, bolts, and gaskets shall be manufactured in accordance with AWWA C153. Bolts and nuts shall be grade 2 or higher.

2.02 Pipeline Identification

- A. All polyethylene pipe shall be marked in accordance with the standards to which it is manufactured.
- B. All polyethylene pipe shall be black, and shall contain a continuous colored stripe, 2 inches wide, located at no greater than 90 degree intervals around the pipe. Stripes shall be impregnated or molded into the pipe by the manufacturer. Application of the stripes after manufacture is not acceptable. Stripe color shall be:
 - 1. Potable Water Mains - blue stripes
 - 2. Reclaimed Water Mains - purple stripes
 - 3. Force Mains - green stripes
 - 4. Sanitary Sewer - green stripes
 - 5. Storm Sewer - no stripes required
- C. Grey or white polyethylene without stripes may be used for gravity or storm sewer applications as approved by the Owner or Engineer.
- D. All black polyethylene without stripes may be used for any installation in the interest of expediting delivery or reducing the cost of installation as approved by the Owner or Engineer.

2.03 Soil Materials

- A. Suitable on-site backfill material – suitable materials shall be defined as a mineral soil reasonably free of foreign materials (rubbish, debris, etc.), clumps, aggregate larger than three inches, rock, concrete or asphalt chunks, and other unsuitable materials, that may damage the pipe installation, prevent thorough compaction, or increase the risks of after settlement unnecessarily.
- B. Imported granular material for pipe bedding and encasement – granular materials furnished for foundation, bedding, pipe encasement, or other purposes as may be specified shall consist of any natural aggregate such as sand, gravel, crushed rock, crushed stone, that shall meet the gradation requirements specified on the Standard Details or project documents. Granular material used for pipe bedding and encasement shall be comprised of virgin materials only.
- C. Imported materials for backfill – when acceptable select grading material is not available within the project site, the Contractor shall furnish granular backfill material meeting DOT and all local right-of-way authority requirements. The backfill material shall be utilized for backfilling from the top of pipe encasement zone up to the subgrade (bottom of road section or bottom of topsoil) at the direction

of the Owner. Granular material used for backfill of utilities pipes shall be comprised of virgin materials.

2.04 Delivery, Storage and Handling of Materials

- A. Contractor is required to inspect materials delivered to the site for damage. All materials found during inspection or during the progress of work to have cracks, flaws, or other defects shall be rejected and removed from the job site without delay.

PART 3 EQUIPMENT

3.01 Data Logger

- A. A data logger shall be used to record and document all butt fusion process. The data logger must be compatible and outfitted with an electronic data recording device. A digital report or printout for all fusion joints made that complies with, but is not limited to, ASTM F3124 must be delivered to the OWNER upon request and at the completion of the project. All hydraulic fusion must be recorded and able to produce a graphic representation of the time and pressure data. All manual fusion must be recorded with, but not limited to, Joint ID, Operator Name and ID, Pipe information, and Heater Plate Temperature. The recording unit shall be a DataLogger 6 as manufactured by McElroy Manufacturing, Inc, or newer model or approved equivalent.

PART 4 EXECUTION

4.01 General

- A. When performing trench excavation, the Contractor is to comply with the OSHA trench safety standards, 29 C.F.R., S. 1962.620, Subpart P and all subsequent revisions or updates adopted by the Department of Labor and Employment Security. The Contractor is to ensure that trench boxes are wide enough to accommodate compaction and density testing. Submission of a bid and subsequent execution of a contract to perform the work required will serve as certification that all trench excavation will be in compliance with OSHA standards.

4.02 Excavation

- A. Excavate pits to permit the placing of the full widths and lengths of trench limits as shown in project documents. Perform all excavation to foundation materials. Wherever rock bottom is secured, excavate in such manner to allow the solid rock to be exposed and prepared to support the foundation for pipe placement.
- B. Excavate trenches for pipes to the elevation of the bottom of the pipe and to a width sufficient to provide adequate working room. Remove soil not meeting the classification specified as suitable backfill material to a depth of 4 inches below the

bottom of the pipe elevation. Remove rock, boulders or other hard lumpy or unyielding material to a depth of 12 inches below the bottom of the pipe elevation. Remove much or other soft material to a depth necessary to establish a firm foundation. Where the soil permit, ensure that the trench sides are vertical up to at least the mid-point of the pipe.

- C. For pipe lines placed above the natural ground line, place and compact the embankment, prior to excavation of the trench, to an elevation at least 2 feet above the top of the pipe and to a width equal to four pipe diameters, and then excavate the trench to the required grade.
- D. For pipe trenches utilizing trench boxes, ensure that the trench box used is of sufficient width to permit thorough tamping of bedding material under and around the pipes.
- E. Do not disturb the installed pipe and its embedment when moving trench boxes. Move the trench box carefully to avoid excavated wall displacement or damage. As the trench box is moved, fill any voids left by the trench box and continuously place and compact the backfill material adjacent to and all along the side of the trench box walls to fill any voids created by the trench box.
- F. Use suitable excavated materials for backfilling over or around the pipe. Dispose of any unsuitable materials. Where acceptable suitable select grading material is available within the project site, the select grading materials shall be utilized for backfilling pipe trench from the top of the pipe encasement zone up to the subgrade.

4.03 Backfilling

- A. Backfill and compaction should follow pipe placement and assembly as closely as possible.
- B. Backfill in dry conditions whenever normal dewatering equipment and methods can accomplish the needed dewatering. A LOT is defined as one lift of backfill material placement, not to exceed 500 feet in length or a single run of pipe connecting two successive structures, whichever is less. Backfill around structures compacted separately from the pipe will be considered as separate LOTs. Backfill on each side of the pipe for the first lift will be considered a separate LOT. Backfill on opposite sides of the pipe for the remaining lifts will be considered separate LOTs, unless the same compactive effort is applied. The same compactive effort is defined as the same type of equipment (make and model) making the same number of passes on both sides of the pipe. For multiple phase backfill, a LOT shall not extend beyond the limits of the phase.
- C. When placing backfill within a trench box each lift of backfill is considered a LOT. Placement of backfill within trench box limits will be considered a complete operation before trench box is moved for next backfill operation. When the trench box is moved for next backfill operation this will start new LOTs for each lift.

- D. Provide normal dewatering equipment including, but not limited to, surface pumps, sump pumps, well points and header pipe and trenching/digging machinery. Provide normal dewatering methods including, but not limited to, constructing shallow surface drainage trenches/ditches, using sand blankets, perforated pipe drains, sumps and siphons.
- E. Backfill to the original ground surface or subgrade surface of openings made for structures, with a sufficient allowance for settlement. The Owner may require that the material used for this backfill be obtained from a source entirely apart from the structure. Use only material accepted by the Owner.
- F. Do not allow heavy construction equipment to cross over pipes until placing and compacting backfill material to the finished earthwork grade or to an elevation at least four feet above the crown of the pipe.
- G. Place the material in horizontal layers not exceeding six inches compacted thickness, in depth above water level and under the haunches of the pipes.
- H. The Contractor may elect to place material in thicker lifts of no more than 12 inches compacted thickness above the Soil Envelope if the Contractor can demonstrate with a successful test section that density can be achieved.
- I. Where wet conditions do not permit the use of mechanical tampers, compact using hand tampers. When the backfill has reached an elevation and condition such as to make the use of the mechanical tampers practical, perform mechanical tamping in such a manner and to such extent as to transfer the compaction force into the sections previously tamped by hand.
- J. For pipes greater than 15 inches in diameter, the Contractor may elect to break the backfill up into four sections: lowest zone, bedding zone, cover zone and top zone.
 - 1. The lowest zone is backfilled for deep undercuts up to within four inches of the bottom of the pipe. Backfill areas undercut below the bedding zone of a pipe with coarse sand, or other suitable granular material. Compact the soil in the lowest zone to approximately match the density of the soil in which the trench was cut.
 - 2. The bedding zone is usually the four inches directly under the pipe. If rock or other hard materials have been removed from the bottom of the trench, the bedding zone shall be the 12 inches of soil below the bottom of the pipe as a replaced foundation. Backfill the bedding zone with suitable Class 1, 2 or 3 materials or other approved by the Owner. If the trench was not undercut below the bottom of the pipe, loosen the soil in the bottom of the trench immediately below the middle third of the outside diameter of the pipe. If the trench was undercut, place the bedding material and leave it in

a loose condition below the middle third of the outside diameter of the pipe. Place the material in lifts no greater than six inches.

3. The cover zone is backfill that is placed after the pipe is laid and extends to a height of 12 inches above the top of the pipe. Backfill the cover zone with suitable Class 1, 2 or 3 materials or other approved by the Owner. Before placing the cover zone material, lay the pipe. Place the material in six inch layers of compacted thickness, evenly deposited on both sides of the pipe, and compact with mechanical tampers suitable for this purpose. Hand tamp material below the pipe haunch that can't be reached by mechanical tampers.
4. The top zone extends from 12 inches above the top of the pipe to the final grade. Backfill the top zone with material suitable for backfill as previously mentioned in this specification. Place the material in layers that do not exceed 12 inches of compacted thickness.

4.04 Density Testing

- A. Compaction of materials placed within the pipe bedding and encasement zones shall be accomplished with portable or hand equipment methods, so as to achieve thorough consolidation under and around the pipe and avoid damage to the pipe. The materials at this level shall be thoroughly compacted with a mechanical compactor to meet 95% of maximum standard proctor density.
- B. Compaction of materials placed above the pipe encasement zones shall be carefully placed in relatively uniform depth layers spread over the full width and length of the trench section to provide simultaneous support on both sides of the excavation. The backfill material shall not exceed 12 inches in compacted thickness.
 1. The compaction for backfill for utility pipe trench under impervious (paved) surface areas shall meet 98% of maximum standard proctor density or other requirements as determined by DOT or the right-of-way authority.
 2. The compaction for backfill for utility pipe trench under pervious (non-paved) surface areas shall meet 95% of maximum standard proctor density or other requirements as determined by DOT or the local right-of-way authority.

4.05 Quality Assurance

- A. Unless otherwise specified in the project documents, a qualified independent inspection and testing agency will be retained by the Owner or Contractor to perform field and laboratory testing and / or evaluations in accordance with the criteria of ASTM D3740 to verify compliance of the work with the requirements of this specification.
- B. The inspection / testing firm shall be responsible for quality assurance inspection and testing to ensure that the work is in accordance with the requirements of the project documents.

- C. If the completed work is not in accordance with the project documents, the Contractor shall be responsible for repairing or reconstructing the deficiencies to meet the project documents at the Contractors expense.
- D. Tests of gradation, plasticity, density and moisture content shall be performed for each type of fill material.
- E. Unless otherwise specified in the project documents, the following in-place dry density and moisture content testing on compacted fill shall be performed using one of the following methods:
 - 1. Sand-cone method in accordance with ASTM D1556
 - 2. Nuclear methods in accordance with ASTM D6938
 - 3. Rubber balloon method in accordance with ASTM D2167
 - 4. Drive-cylinder method in accordance with ASTM D2937
- F. Unless otherwise specified in the project documents, the field density testing shall be performed at the following frequencies:
 - 1. Structural fill under roadways, railroads, pavement and parking areas – one test every 200 square feet of each lift
 - 2. Road base and sub-base – one test every 2000 square feet of each lift
 - 3. Backfill of trenches – one test for every 150 linear feet of each lift and one test within each segment between changes in direction

4.06 Pipe Joining

- A. High density polyethylene pipe shall be heat fused and pressure tested as per manufacturer's guidelines before installation. During assembly and prior to installation, pipe must be laid out in such a way as to minimize interference to pedestrian and vehicular traffic.
- B. Cuts or gouges that reduce the wall thickness by more than 10% are not acceptable and must be cut out, discarded and the pipe rejoined.
- C. Each butt fusion shall be recorded and logged by a datalogger affixed to the fusion machine. Joint data shall be submitted as part of the as-built documentation.
- D. Electrofusion joining?
- E. Mechanical joining – Polyethylene pipe and fittings may be joined together or to other materials by means of flanged connections or mechanical couplings designed for joining polyethylene pipe or for joining polyethylene pipe to another pipe material. Mechanical couplings shall be fully pressure rated and fully thrust restrained and installed in accordance with manufacturer's recommendations.

4.07 Disinfection Testing

A. Disinfection tests

1. All water pipe and fittings shall be thoroughly disinfected prior to being placed in service. Disinfection shall follow the applicable provisions of the procedure established for the disinfection of water mains as set forth in AWWA C651. Bacteriological testing on the water main shall be scheduled, completed and sent for water analysis (lab testing.) The results of the lab testing shall be sent to the Owner. No pipeline shall be placed into service until it is properly disinfected and water analysis proves it is disinfected.
2. Temporary blow-offs shall be installed for the purpose of cleaning the water main. Temporary blow-offs shall be removed and plugged after the main is cleared. The main shall be flushed prior to disinfection.
3. The new water main shall be connected to the existing water main at one point only for flushing purposes. The new main **MUST** have a blow off on the end as required. After the new main is thoroughly flushed, the open end shall be sealed and restrained and the main shall be thoroughly disinfected.

4.08 Pressure and Leakage Testing

A. Summary of Practice of Pressure and Leakage Testing

1. The section of the piping to be tested is isolated from other parts of the system and properly restrained in order to prevent failure of both the test section and the existing system connected to the test section. Isolated sections of the test section are vented to the atmosphere in order to ensure compressible gases do not remain within the hydraulic test section. The test section is filled with liquid, raised to the test pressure, and allowed to stabilize. The system is then inspected for leakage and the pressure is relieved. Any required repairs or replacements are then performed while the pipe is depressurized.
2. There is no leakage allowance, as properly made heat-fusion joints of HDPE do not leak. However, if any defects or leaks are revealed, they should be corrected and the pipeline retested after a minimum 24 hour recuperation period between tests. Total testing conducted on a section of pipeline shall not exceed eight hours within a 24 hour period.
3. An expansion allowance is allowed as HDPE will expand slightly due to elasticity and Poisson effects. The amount of make-up water (expansion allowance) will vary because expansion is not linear. This procedure compensates for expansion with an initial expansion phase followed by a testing phase as to which the test pressure is reduced suspending expansion. Expansion or contraction due to Poisson effects may disjoin other non-restrained joints, such as bell and spigot joints, so measures must be taken to fully restrain the test section.

B. Style of Testing

1. Conduct hydrostatic pressure testing of installed polyethylene pipe in accordance with ASTM F2164, Standard Field Leak Testing of Polyethylene Pipe and Crosslinked Polyethylene Piping Systems Using Hydrostatic Pressure.
2. It is not permitted to conduct pneumatic leak testing on HDPE in accordance with ASTM F2786, Standard Practice for Leak Testing of Polyethylene Piping Systems Using Gaseous Media Under Pressure (Pneumatic Leak Testing.)
3. Non-pressurized HDPE sewer mains may be pressure tested following ASTM F1417 Standard Practice for Installation Acceptance of Plastic Non-pressure Sewer Lines Using Low-Pressure Air.

C. Non-HDPE Components

1. Non-HDPE components, such as end caps, valves, etc., that are used to isolate the test section from other parts of the system in order to perform the test are required to be rated for pressures equal to or greater than the test pressure applied to the test section. These non-HDPE components must be properly restrained while conducting the pressure test.
2. Air release valves must be installed at the high points of the test section to allow for the release of any air or gases within the pipe prior to performing the required hydraulic pressure testing.
3. Pumping equipment used to pressurize the test section during the pressure testing should be of adequate capacity to fill, pressurize and test the section within the allotted time for the test.
4. A pressure monitoring gage is recommended to be connected to the test section at the lowest point to ensure the highest pressure is recorded within the test section. The combination of pump pressure and pressure at higher elevations will be recorded at the lowest point of the test section. Constant monitoring of the pressure during testing is required. A datalogger with a pressure recording transducer can be attached to the pressure gage to record pressure readings during the test. Additional gauges capturing the quantity of water used to fill prior to initial pressure testing and make up water during testing are required.

D. Safety

1. Take the necessary safety precautions to ensure the test is conducted safely during the entirety of the testing period. Persons operating near the test string should be familiar with pressure testing and understand the safety precautions necessary to perform the test safely.
2. The test section should be supervised at all times during pressure testing.
3. Failure of the HDPE pipe string may result in sudden, violent, uncontrolled and dangerous movement of the system piping, components or parts of the

components.

E. Restraint against movement

1. Measures should be taken to ensure all parts and components of the pipe section under pressure testing should be restrained from movement either through the use of partial backfill or adequate above ground restraint methods.

F. Pre-test preparation and set-up

1. HDPE pipe materials are rated at temperatures of 73°F or less. Pressure testing at higher temperatures will require de-rating of the pipe and fittings in accordance with the manufacturer's recommendations.
2. Prior to testing, all heat fusion joints are to be completely cooled and allowed to cool beyond the required rough handling time.
3. The pipe string and components required to be tested should be flushed, pigged or otherwise cleaned to remove dirt and debris that may damage parts or components involved in the pressure testing.

G. Maximum test pressures

1. The maximum test pressure of should not exceed the Owner's or Engineer's recommendations.
2. System operating pressures often refer to the actual pressure that the municipal water and wastewater pipeline systems experience during actual operation.
3. System design pressures often refer to the pressure rating of the HDPE pipeline that will be installed within the municipal water and wastewater pipeline system. HDPE pipe utilized in municipal water and wastewater systems often have higher rated design pressures than the operating pressures of the pipe systems they are installed within.
4. System operating and system design pressures are not always equal. It is necessary to establish if there is a difference between system operating and system design pressures. The Owner or Engineer will make a determination if the system operating pressure or system design pressures will be used to perform pressure and leakage tests on the pipe string.
5. The maximum test pressure for HDPE shall not exceed 1.5 times the system design pressure when lower pressure rated components or devices are not present. The maximum test pressure for HDPE shall not exceed the pressure rating of the lowest pressure rated components when they are present.

H. Test duration

1. The test duration required to pressurize, stabilize, hold test pressure and depressurize shall not exceed 8 hours. If retesting is necessary, the test

- section shall be depressurize for a minimum of 8 hours prior to restarting.
2. Prior to pressurizing, all components must be inspected to be in proper working conditions, all components of the test section shall be vented to atmosphere and all low pressure lines not part of the test section shall be disconnected from the test section.

I. Hydrostatic Test Procedure

1. The test section shall be filled slowly with liquid and all air is purged from the system. It is important to take steps to ensure all air is purged from the system. The flow velocity of liquid within the test section should not exceed the capacity of air to be purged from the system or the allowable design velocity of the pipe.
2. The test section should be allowed to come to temperature equilibrium between the pipe string and the fluid within the pipe.
3. When the test section is filled with fluid and purged with air, the pressure within the test section shall be gradually increased to the required test pressure. Make-up water should be allowed to fill the test section to maintain the required pressure due to expansion of the test section.
4. Once the pipe has stabilized, the pressure should be reduced 10 psi and the pressure monitored for 1 hour. The pressure should not be increased nor makeup water added to the test section during the observation period.
5. If not leakage occurs or if the internal pressure remains within 5% of the test phase pressure, the pressure test has passed.

J. Post test submittals

1. All records kept during pressure testing shall be provided to the Owner and Engineer.
2. Pressure test reports shall include the test liquid, backflow prevention devices, if used, weather conditions and ambient temperature at site of testing, test pressure, types of test gauges, location of test gauges including location distances and elevations, gauge calibration records, test pressures recorded, any adjustments made such as makeup water, etc, description of leaks or failures, date and time, and operator performing the pressure test.

4.09 Restoration

After completion of the excavation, backfill and compaction work all work areas, staging and storage areas are to be restored to equal or better condition than pre-construction condition.

END OF SECTION