

SECTION 20

HORIZONTAL DIRECTIONAL DRILLING (HDD)/HDPE PIPE

20.01 SCOPE:

A. General:

It is the intent of this specification to define the acceptable methods and materials for installing sanitary sewer and water mains by the horizontal directional drilling method and the requirements for high density polyethylene (HDPE) pipe installed by directional drilling or in open cut trenches.

B. Installation Plan:

1. At least 7 days prior to mobilizing equipment Contractor shall submit his detailed installation plan to the Engineer. The plan shall include a detailed plan and profile of the bores and be plotted at a scale no smaller than 1 inch equals 20 feet horizontal and vertical.
2. The plan shall also include a listing of major equipment and supervisory personnel and a description of the methods to be used.

C. Variations in Plan or Profile:

The Contractor may request changes to the proposed vertical and horizontal alignment of the installation and the location of the entry and exit points. Proposed changes shall be submitted in writing to the Engineer and receive approval of the Engineer prior to construction.

D. Alignment:

The proposed plan and profile installation locations are based on alignments to accommodate acquired easements, to avoid obstructions, and to properly maintain operation flow velocities.

E. Qualifications:

Directional drilling and pipe installation shall be done only by an experienced Contractor specializing in directional drilling and whose key

personnel have at least five (5) years experience in this work. Furthermore, the Contractor shall have installed directionally drilled pipe at least as large as 20 inches in diameter, have performed crossings at least 2,000 feet in length, and successfully installed at least 100,000 feet in length.

20.02 MATERIALS:

A. General:

High density polyethylene pipe in accordance with Paragraph 12.03E of the Owner's Standard Specifications in addition to these specifications shall be used in HDD installations. All piping system components shall be the products of one manufacturer and shall conform to the latest edition of ASTM D1248, ASTM D3350, and ASTM F714.

B. Piping and Bends:

Piping and Bends shall be extruded from a polyethylene compound and shall conform to the following requirements:

1. The polyethylene resin shall meet or exceed the requirements of ASTM D3350 for PE 3408 material with a cell classification of 335434C, or better.
2. The polyethylene compound shall be suitably protected against degradation by ultraviolet light by means of carbon black, well dispersed by precompounding in a concentration of not less than 2 percent.
3. The maximum allowable hoop stress shall be 800 psi at 73.4 degrees F.
4. The pipe manufacturer shall be listed with the Plastic Pipe Institute as meeting the recipe and mixing requirements of the resin manufacturer for the resin used to manufacture the pipe in this project.

5. The pipe and bends shall have a minimum standard dimension ratio (SDR) wall thickness as specified by the Engineer.
6. Joining shall be performed by thermal butt-fusion in accordance with the manufacturer's recommendations.
7. Sanitary sewer pipe exterior shall be green in color or contain green striping. Sanitary sewer pipe interior shall be light in color for internal video inspection.
8. Water pipe exterior shall be blue in color or contain blue striping.

C. Procedures:

1. General:

All polyethylene pipe shall be cut, fabricated, and installed in strict conformance with the pipe manufacturer's recommendations. Joining, laying, and pulling of polyethylene pipe shall be accomplished by personnel experienced in working with polyethylene pipe. The pipe supplier shall certify in writing that the Contractor is qualified to join, lay, and pull the pipe or representative of the pipe manufacturer shall be on site to oversee the pipe joining. Expense for the representative shall be paid for by the Contractor.

2. Transportation:

Care shall be taken during transportation of the pipe to ensure that it is not cut, kinked, or otherwise damaged.

3. Storage:

Pipes shall be stored on level ground, preferably turf or sand, free of sharp objects which could damage the pipe. Stacking of the polyethylene pipe shall be limited to a height that will not cause excessive deformation of the bottom layers of pipes under anticipated temperature condition. Where necessary due to ground conditions, the pipe shall be stored on wooden sleepers, spaced suitably and of such widths as not to allow deformation of the pipe at the point of

contact with the sleeper or between supports.

4. Handling Pipe:

The handling of the joined pipeline shall be in such a manner that the pipe is not damaged by dragging it over sharp and cutting objects. Ropes, fabric, or rubber-protected slings and straps shall be used when handling pipes. Chains, cables, or hooks inserted into the pipe ends shall not be used. Two slings spread apart shall be used for lifting each length of pipe. Pipe or fittings shall not be dropped onto rocky or unprepared ground. Slings for handling the pipeline shall not be positioned at butt-fused joints. Sections of the pipes with cuts and gouges exceeding 10 percent of the pipe wall thickness or kinked sections shall be removed and the ends rejoined.

The open ends of all sections of joined and/or installed pipe (not in service) shall be plugged at night to prevent animals or foreign material from entering the pipe line or pipe section.

Waterproof nightcaps of approved design may be used but they shall also be so constructed that they will prevent the entrance of any type of natural precipitation into the pipe and will be fastened to the pipe in such a manner that the wind cannot blow them loose.

The practice of stuffing cloth or paper in the open ends of the pipe will be considered unacceptable.

Where possible, the pipe shall be raised and supported at a suitable distance back from the open end such that the open end will be below the level of the pipe at the point of support.

20.03 INSTALLATION:

A. General:

1. The Contractor shall install the pipelines by means of horizontal directional drilling. The Contractor shall assemble, support, and

pretest the pipeline prior to installation in the directional drill tunnel.

2. Horizontal directional drilling shall consist of the drilling of a small diameter pilot hole from one end of the alignment to the other, followed by enlarging the hole diameter for the pipeline insertion. The exact method and techniques for completing the directionally drilled installation will be determined by the Contractor, subject to the requirements of these Specifications.
3. The Contractor shall prepare and submit a plan to the Engineer for approval for insertion of the HDPE pipe into the opened bore hole. This plan shall include pullback procedure, ballasting, use of rollers, side booms and side rollers, coating protection, internal cleaning, internal gauging, hydrostatic tests, dewatering, and purging.
4. The required piping shall be assembled in a manner that does not obstruct adjacent roadways or public activities. The Contractor shall erect temporary fencing around the entry and exit pipe staging areas.

B. Joining Pipe Sections:

1. Each length of pipe shall be inspected and cleaned as necessary to be free of debris immediately prior to joining.
2. Pipes shall be joined to one another by means of thermal butt-fusion. Polyethylene pipe lengths to be joined by thermal butt-fusion shall be of the same type, grade, and class of polyethylene compound and supplied from the same raw material supplier.
3. Mechanical connections of the polyethylene pipe to auxiliary equipment shall be through flanged connections which shall consist of the following:
 - a. A polyethylene "sub end" shall be thermally butt-fused to the ends of the pipe.
 - b. Provide ASTM A240, Type 304 stainless steel backing flange, 125-pound, ANSI B16.1 standard, and gaskets as required by the manufacturer.

- c. Stainless Steel bolts and nuts of sufficient length to show a minimum of three complete threads when the joint is made and tightened to the manufacturer's standard. Retorque the nuts after 4 hours.
- d. Butt-Fusion Joining: Butt-fusion of pipes shall be performed in accordance with the manufacturer's recommendations as to equipment and technique. Butt-fusion joining shall be 100% efficient offering a joint weld strength equal to or greater than the tensile strength of the pipe.

C. Testing:

1. The pipe shall be hydrostatically tested after joining into continuous lengths prior to installation and again after installation. Pressure and temperature shall be monitored with certified instruments during the test. After this test, the water will be removed with pigs. Erosion prevention procedures will be used during removal and discharge of the water.
2. Hydrostatic testing shall be performed in accordance with paragraph 11.16 of the Owner's Standard Specifications. All costs associated with acquiring water for testing shall be included in the established contract unit bid prices.

D. Tolerances:

1. Pipe installed by the directional drilled method must be located in plan as shown on the Drawings, and must be no shallower than shown on the Drawings unless otherwise approved. The Contractor shall plot the actual horizontal and vertical alignment of the pilot bore at intervals not exceeding 30 feet. This "as built" plan and profile shall be updated as the pilot bore is advanced. The Contractor shall at all times provide and maintain instrumentation that will accurately locate the pilot hole and measure drilling fluid flow and pressure. The Contractor shall grant the Engineer access to all data and readout pertaining to the position of the bore head and the fluid pressures and flows.

When requested, the Contractor shall provide explanations of this position monitoring and steering equipment. The Contractor shall employ experienced personnel to operate the directional drilling equipment and, in particular, the position monitoring and steering equipment. No information pertaining to the position or inclination of the pilot bores shall be withheld from the Engineer.

2. Each exit point shall be located as shown with an over-length tolerance of 10 feet for directional drills of 1,000 linear feet or less and 40 feet for directional drills of greater than 1,000 linear feet and an alignment tolerance of 5 feet left/right with due consideration of the position of the other exit points and the required permanent easement. For gravity sanitary sewer installations, sags in the pipeline shall not exceed 25 percent of the nominal pipe diameter. Sags will only be allowed where the entering and exiting grades are adequate to provide velocities through the sag area sufficient for moving solids. No more than one (1) sag area shall occur between two (2) manholes. The alignment of each pilot bore must be approved by the Engineer before pipe can be pulled. If the pilot bore fails to conform to the above tolerances, the Engineer may, at his option, require a new pilot boring to be made.
3. After the pipe is in place, cleaning pigs shall be used to remove residual water and debris. After the cleaning operation, the Contractor shall provide and run a sizing pig to check for anomalies in the form of buckles, dents, excessive out-of-roundness, and any other deformations. The sizing pig run shall be considered acceptable if the survey results indicate that there are no sharp anomalies (e.g. dens, buckles, gouges, and internal obstructions) greater than 2 percent of the nominal pipe diameter, or excessive ovality greater than 5 percent of the nominal pipe diameter. For gauging purposes, dent locations are those defined above which occur within a span of five feet or less. Pipe ovality shall be measured as the percent difference between the maximum and minimum pipe diameters. For gauging

purposes, ovality locations are those defined above which exceed a span of five feet.

E. Ream and Pullback:

1. **Reaming:** Reaming operations shall be conducted to enlarge the pilot after acceptance of the pilot bore. The number and size of such reaming operations shall be conducted at the discretion of the Contractor.
2. **Pulling Loads:** The maximum allowable pull exerted on the HDPE pipelines shall be measured continuously and limited to the maximum allowed by the pipe manufacturer so that the pipe or joints are not overstressed.
3. **Torsion and Stresses:** A swivel shall be used to connect the pipeline to the drill pipe to prevent torsional stresses from occurring in the pipe.
4. The lead end of the pipe shall be closed during the pullback operation.
5. **Pipeline Support:** The pipelines shall be adequately supported by rollers and side booms and monitored during installation so as to prevent over stressing or buckling during the pullback operation. Such support/rollers shall be spaced at a maximum of 60 feet on centers, and the rollers to be comprised of a non-abrasive material arranged in a manner to provide support to the bottom and bottom quarter points of the pipeline allowing for free movement of the pipeline during pullback. Surface damage shall be repaired by the Contractor before pulling operations resume.
6. The contractor shall at all times handle the HDPE pipe in a manner that does not overstress the pipe. Vertical and horizontal curves shall be limited so that wall stresses do not exceed 50% of yield stress for flexural bending of the HDPE pipe. If the pipe is buckled or otherwise damaged, the damaged section shall be removed and replaced by the Contractor at his expense. The Contractor shall take appropriate steps during pullback to ensure that the HDPE pipe will be installed without damage.

F. Handling Drilling Fluids and Cuttings:

1. During the drilling, reaming, or pullback operations, the Contractor shall make adequate provisions for handling the drilling fluids, or cuttings at the entry and exit pits. To the greatest extent practical, these fluids must not be discharged into the waterway. When the Contractor's provisions for storage of the fluids or cuttings on site are exceeded, these materials shall be hauled away to a suitable legal disposal site. The Contractor shall conduct his directional drilling operation in such a manner that drilling fluids are not forced through the subbottom into the waterway. After completion of the directional drilling work, the entry and exit pit locations shall be restored to original conditions. The Contractor shall comply with all permit provisions.
2. Pits constructed at the entry or exit point area shall be so constructed to completely contain the drill fluid and prevent its escape to the beach or waterway.
3. The Contractor shall utilize drilling tools and procedures which will minimize the discharge of any drill fluids. The Contractor shall comply with all mitigation measures listed in the required permits and elsewhere in these Specifications.
4. To the extent practical, the Contractor shall maintain a closed loop drilling fluid system.
5. The Contractor shall minimize drilling fluid disposal quantities by utilizing a drilling fluid cleaning system which allows the returned fluids to be reused.
6. As part of the installation plan specified herein before, the Contractor shall submit a drilling fluid plan which details types of drilling fluids, cleaning and recycling equipment, estimated flow rates, and procedures for minimizing drilling fluid escape.

20.04 DRILLING OPERATIONS:

A. General:

The Contractor shall prepare a plan to be submitted for Engineer approval which describes the noise reduction program, solids control plant, pilot hole drilling procedure, the reaming operation, and the pullback procedure. All drilling operations shall be performed by supervisors and personnel experienced in horizontal directional drilling. All required support, including drilling tool suppliers, survey systems, mud cleaning, mud disposal, and other required support systems used during this operation shall be provided by the Contractor.

Drill pipe shall be API steel drill pipe, Range 2, Premium Class or higher, Grade S-135 in a diameter sufficient for the torque and longitudinal loads and fluid capacities required for the work. Only drill pipe inspected under API's Recommended Practice Specification API RP 7G within 30 days prior to start and certified as double white band or better shall be used.

A smoothly drilled pilot hole shall follow the design centerline of the pipe profile and alignment described on the construction drawings.

The position of the drill string shall be monitored by the Contractor with the downhole survey instruments. Contractor shall compute the position in the X, Y and Z axis relative to ground surface from downhole survey data a minimum of once per length of each drilling pipe (approximately 31 foot interval). Deviations from the acceptable tolerances described in the Specifications shall be documented and immediately brought to the attention of the Engineer for discussion and/or approval. The profile and alignment defined on the construction drawings for the bores define the minimum depth and radius of curvature. At no point in the drilled profile shall the radius of curvature of the bore be less than 1,600 feet. The Contractor shall maintain and provide to the Engineer, upon request, the data generated by the downhole survey tools in a form suitable for independent calculation of the pilot hole profile.

Between the water's edge and the entry or exit point the Contractor shall provide and use a separate steering system employing a ground survey grid system, such as "TRU-TRACKER" or equal wherever possible. The exit point shall

fall within a rectangle 10 feet wide and 40 feet long centered on the planned exit point.

During the entire operation, waste and leftover drilling fluids from the pits and cuttings shall be dewatered and disposed of in accordance with all permits and regulatory agencies requirements. Remaining water shall be cleaned by Contractor to meet permit requirements.

Technical criteria for bentonite shall be as given in API Spec. 13A, Specification for Oil Well Drilling Fluids Material for fresh water drilling fluids. Any modification to the basic drilling fluid involving additives must describe the type of material to be used and be included in Contractor's drilling plan presented to the Engineer. The Owner retains the right to sample and monitor the waste drilling mud, cuttings and water.

B. Environmental Provisions:

The Horizontal Directional Drilling operation is to be operated in a manner to eliminate the discharge of water, drilling mud and cuttings to the adjacent creek or land areas involved during the construction process. The Contractor shall provide equipment and procedures to maximize the recirculation or reuse of drilling mud to minimize waste. All excavated pits used in the drilling operation shall be lined by Contractor with heavy duty plastic sheeting with sealed joints to prevent the migration of drilling fluids and/or ground water.

The Contractor shall visit the site and must be aware of all structures and site limitations at the directional drill crossing and provide the Engineer with a drilling plan outlining procedures to prevent drilling fluid from adversely affecting the surrounding area.

The general work areas on the entry and exit sides of the crossing shall be enclosed by a berm to contain unplanned spills or discharge.

Waste cuttings and drilling mud shall be processed through a solids control plant comprised as a minimum of sumps, pumps, tanks, desalter/desander, centrifuges, material handlers, and haulers all in a quantity sufficient to perform the cleaning/separating operation without interference with the drilling program. The

cuttings and excess drilling fluids shall be dewatered and dried by the Contractor to the extent necessary for disposal in offsite landfills. Water from the dewatering process shall be treated by the Contractor to meet permit requirements and disposed of locally. The cuttings and water for disposal are subject to being sampled and tested. The construction site and adjacent areas will be checked frequently for signs of unplanned leaks or seeps.

Equipment (graders, shovels, etc.) and materials (such as groundsheets, hay bales, booms, and absorbent pads) for cleanup and contingencies shall be provided in sufficient quantities by the Contractor and maintained at all sites for use in the event of inadvertent leaks, seeps or spills.

Waste drilling mud and cuttings shall be dewatered, dried, and stock piled such that it can be loaded by a front end loader, transferred to a truck and hauled offsite to a suitable legal disposal site. The maximum allowed water content of these solids is 50% of weight.

Due to a limited storage space at the worksites, dewatering and disposal work shall be concurrent with drilling operations. Treatment of water shall satisfy regulatory agencies before it is discharged.

END OF SECTION