

Section 02450

HORIZONTAL DIRECTIONAL DRILLING

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes:

1. Installing water line by directional drilling methods.

1.02 MEASUREMENT AND PAYMENT

A. Unit Prices.

1. Payment for water lines installed by horizontal directional drilling is on linear foot basis for each size of pipe installed. Measure along axis of pipe and include fittings and valves. Payment for excavation to determine obstructions will be made based on unit prices for extra Work.
2. Refer to Section 01270 – “Measurement and Payment” for unit price procedures.

1.03 REFERENCES

- A. NSF 61 – Drinking Water System Components – Health Effects.
- B. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 60 In.
- C. AWWA C906 - Polyethylene (PE) Pressure Pipe and Fittings, 4 In. Through 65 In. for Waterworks

1.04 SUBMITTALS

A. Conform to requirements of Specification Section 01330- Submittal Procedures.

B. Pre-construction submittal package to include the following items:

1. Horizontal Directional Drilling methodology. A brief description of directional drilling methodology. Description to be sufficient to convey:
 - a. Names of directional boring machine operator and directional boring machine navigational equipment operator.

- b. Manufacturer and type of directional drilling equipment proposed.
 - c. Satisfactory documentation of worker's directional drilling qualifications.
 - d. Number and duration of shifts planned to be worked each day.
 - e. Proposed pit sizes and locations.
 - f. Sequence of operation.
 - g. Locations of directional drilling equipment and work sites, including verification of pilot bore location.
 - h. Method of soils transportation, surface storage and disposal location.
 - i. Identify critical utility crossings and special precautions proposed.
2. Contractor shall submit for approval a drilling fluid management plan detailing proposed methods to control, collect, transport, and dispose of drilling fluids and spoils.
 3. Provide means for accurately monitoring location of pilot bore throughout bore using electronic detection system. Electronic detection equipment must be capable of achieving accuracy within 0.1 feet at all points throughout bore.
 4. Proposed changes shall be submitted in writing to the Project Manager and receive written approval prior to construction. The proposed entry point must remain in the location shown on the approved submittal.
 5. The following product data:
 - a. Pipe size
 - b. Dimensionality
 - c. Pressure class per applicable standard
 - d. Recommended minimum bending radius
 - e. Recommended maximum safe pulling force and controls to help not exceed that force
 - f. Fusion technician qualifications and welding procedures

- C. Post construction submittals shall contain at least the following:
1. As-recorded Information
 - a. The as-recorded plan and profile shall reflect the actual installed alignment, and reflect the horizontal offset from the baseline and depth of cover.
 - b. All fittings, valves, or other appurtenances shall also be referenced and shown.
 - c. A daily project log, along with tracking log sheets, should they be used, shall be provided. Tracking log sheet data, should it be employed, shall include inclination, depth, azimuth, and hydraulic pull-back and rotational force measured.
 2. Approved datalogger device reports.
 3. When fusion joints are used, fusion joint documentation containing the following:
 - a. Pipe size and thickness
 - b. Machine size
 - c. Fusion technician identification
 - d. Job identification
 - e. Fusion joint number
 - f. Fusion, heating and rag pressure setting
 - g. Heat plate temperature
 - h. Time stamp
 - i. Heating and cool down time of fusion
 - j. Ambient temperature

1.05 RELATED REQUIREMENTS

- A. Section 01270 – “Measurement and Payment”
- B. Section 01330 – “Submittal Procedures”
- C. Section 01555 – “Traffic Control and Regulation”

- D. Section 01576 – “Waste Material Disposal”
- E. Section 02317 – “Excavation and Backfill for Utilities”
- F. Section 02505 – “High Density Polyethylene (HDPE) Pipe”
- G. Section 02506 – “Polyvinyl Chloride Pipe”
- H. Section 02514 – “Disinfection of Water Lines”
- I. Section 02515 – “Hydrostatic Testing of Pipelines”
- J. Section 02951 – “Pavement Repair and Resurfacing”

1.06 QUALITY ASSURANCE

- A. Work specified herein shall be performed by trained workers who have minimum of 5 years of experience with directional drilling equipment and have successfully completed directional drilling installations of utilities similar in size and nature.
- B. Similar installations: Horizontal Directional Drilling completed in an urbanized area with geological conditions similar to those at the site. River crossing installations and cable or phone duct installations are not considered similar due to significantly different drilling techniques involved.
- C. When fusible pipe is used, fusion technician shall be fully qualified by the pipe supplier to install fusible pipe of the type and size being used. Qualification shall be current as of the actual date of fusion performance on the project.

1.07 SYSTEM DESCRIPTION

- A. Design Criteria
 - 1. Select appropriate pipe to carry forces resulting from pull-back of pipe through reamed hole, or other construction loads in combination with overburden, earth and external hydrostatic loads, and internal pressure.
 - 2. Provide pipe with inside diameter conforming to minimum requirements of Plans.
 - 3. Offset soil borings at least 50 feet from centerline.

1.08 – 1.09 NOT USED

1.10 DEFINITIONS

- A. Horizontal Directional Drilling: A method of installing pipe that begins with boring a small, horizontal hole (pilot hole) underground with a continuous string of steel drill rod. When bore head and rod emerge at opposite side of crossing, a special cutter, called a reamer, is attached and pulled back through the pilot hole to pull pipe through.
- B. Pilot Hole: Establishes path of drill rod and subsequent location of pipe.
- C. Pilot Hole Reaming: Operation consists of using appropriate tool to open pilot hole to a slightly larger diameter than water line.

1.11-1.13 NOT USED

PART 2 PRODUCTS

2.01 MANUFACTURER(S) (NOT USED)

2.02 MATERIALS AND/OR EQUIPMENT

A. Water Line

- 1. Provide AWWA C906 HDPE Pipe with fused joints in accordance with Specification Section 02505 – “High Density Polyethylene (HDPE) Pipe”.
- 2. Provide Certa-Lok C900 RJIB (Restrained Joint Integral Bell) DR14 PVC Pipe in accordance with AWWA C900, and Section 02506 – “Polyvinyl Chloride Pipe”.
- 3. Provide fusible AWWA C900 PVC with minimum DR18 pressure ratings and blue in color in accordance with Section 02506 – “Polyvinyl Chloride Pipe”.

B. Drilling System Equipment

1. General

- a. The directional drilling equipment, as a minimum, shall consist of a directional drilling rig of sufficient capacity to perform the bore(s) and pull-back of the pipe(s), a drilling fluid mixing & delivery system of sufficient capacity to successfully complete the crossing, a guidance system to accurately guide boring operations, and trained and competent personnel to operate the system.
- b. All equipment shall be in good, safe operating condition with sufficient supplies, materials and spare parts on hand to maintain the system in good working order for the duration of this project.

2. Drilling Rig
 - a. The directional drilling machine shall consist of a hydraulically powered system to rotate, push and pull drill pipe while delivering a pressurized fluid mixture to a drill head. The machine shall be anchored to withstand the pulling, pushing and rotating forces required to complete the project.
 - b. The drilling rig hydraulic system shall be of sufficient pressure and volume to power drilling operations. The hydraulic system shall be free from leaks.
 - c. The drilling rig shall have a system to monitor pull-back hydraulic pressure during pull-back operations.
3. Drill Head
 - a. The horizontal directional drilling equipment shall produce a stable fluid lined tunnel with the use of a steer-able drill head and any subsequent pre-reaming heads.
 - b. The system must be able to control the depth and direction of the drilling operation.
 - c. Drill head shall contain all necessary cutters and fluid jets for the operation, and shall be of the appropriate design for the ground medium being drilled.
4. Drilling Fluid System
 - a. Drilling Fluid (Drilling Mud)
 - 1) Drilling fluid shall be composed of clean water and the appropriate additive(s) for the fluid to be used. Water shall be from a clean source and shall meet the mixing requirements of the mixture manufacturer(s).
 - 2) The water and additives shall be mixed thoroughly to assure the absence of any clumps or clods. No hazardous additives may be used.
 - 3) Drilling fluid shall be maintained at a viscosity sufficient to suspend cuttings and maintain the integrity of bore wall(s).

- 4) Drilling fluid shall be disposed of off-site in accordance with local, state and federal requirements and/or permit conditions.
 - 5) No additional chemicals or polymer surfactants shall be allowed to be added to the drilling fluid unless they have been submitted per this Specification.
- b. Mixing System
- 1) A drilling fluid mixing system shall be of sufficient size to mix and deliver drilling fluid for the project.
 - 2) The mixing system shall be able to ensure thorough mixing of the drilling fluid. The drilling fluid reservoir tank shall be sized for adequate storage of the fluid.
 - 3) The mixing system shall continually agitate the drilling fluid during drilling operations.
- c. Drilling Fluid Delivery and Recovery System
- 1) The drilling fluid pumping system shall have a minimum capacity to supply drilling fluid in accordance with the drilling equipment pull-back rating at a constant required pressure.
 - 2) The delivery system shall have filters or other appropriate in-line equipment to prevent solids from being pumped into the drill pipe.
 - 3) Used drilling fluid and drilling fluid spilled during drilling operations shall be contained and properly disposed of. The use of spill containment measures shall be maintained around drill rigs, drilling fluid mixing system, entry and exit locations and drilling fluid recycling system (if used) to prevent spills into the surrounding environment. Pumps, vacuum truck(s), and/or storage of sufficient size shall be in place to contain excess drilling fluid.
 - 4) A closed-loop drilling fluid system and a drilling fluid cleaning system should be used to whatever extent practical, depending upon project size and conditions. Under no circumstances shall

drilling fluid that has escaped containment be reused in the drilling system.

5. Drilling Control System

- a. Calibration of the electronic detection and control system shall be verified prior to the start of the bore.
- b. The drilling head shall be remotely steer-able by means of an electronic or magnetic detection system. The drilling head location shall be monitored in three dimensions:
- c. Offset from the baseline,
- d. Distance along the baseline, and
- e. Depth of cover.
- f. Point of rotation of the head shall also be monitored.
- g. For gravity application and on-grade drilling, sonde/beacon or approved equipment applicable for grade increments of 1/10th of one percent shall be used.

6. Pipe Pull Heads

- a. Pipe pull heads shall be utilized that employ a positive through-bolt design assuring a smooth wall against the pipe cross-section at all times.
- b. Pipe pull heads shall be as recommended by the pipe supplier.

2.03 FABRICATION (NOT USED)

2.04 SOURCE QUALITY CONTROL

- A. Pipe shall be homogeneous throughout and be free of visible cracks, holes, foreign material, blisters, or other visible deleterious faults.

PART 3 EXECUTION

3.01 GENERAL / MANUFACTURER(S) (NOT USED)

- A. General

1. Bore path and alignment are as indicated in the contract documents. The path of the bore may be modified based on field and equipment conditions. Entry and exit locations and control-point elevations shall be maintained as indicated in the contract documents.
 2. Bend radii shown in the contract documents are minimum allowable radii and shall not be reduced.
- B. Location and Protection of Underground Utilities
1. Utility location and notification services shall be contacted by the Contractor prior to the start of construction.
 2. It is the Contractor and HDD system operator's responsibility to determine this envelope of safe offset from existing utilities. This shall include, but is not limited to, soil conditions and layering, utility proximity and material, HDD system and equipment, and foreign subsurface material.
- C. Drilling Layout and Tolerances
1. The drill path shall be accurately surveyed with entry and exit locations as indicated on Plans. If using a magnetic guidance system, drill path shall be surveyed for any surface geomagnetic variations or anomalies.
 2. Instrumentation shall be provided and maintained at all times that accurately locates the pilot hole, measures drill-string axial and torsional loads and measures drilling fluid discharge rate and pressure.
 3. Entry and exit locations shall be drilled so as not to exceed the bending limitations of the pipe as recommended by the pipe manufacturer.
- D. Pilot Hole Bore
1. Pilot hole shall be drilled along bore path. In the event that the pilot bore does deviate from the bore path, it may require contractor to pull-back and re-drill from the location along bore path before the deviation.
 2. The Contractor shall limit curvature in any direction to reduce force on the pipe during pull-back. The minimum radius of curvature shall be no less than that specified by the pipe manufacturer and as indicated on the Plans.
- E. Reaming

After successfully completing the pilot hole, the bore hole shall be reamed to a diameter which meets the requirements of the pipe being installed:

1. Multiple reaming passes shall be used at the discretion of the Contractor and shall conform to this specification.
2. In the event of a drilling fluid fracture, returns loss or other loss of drilling fluid, the Contractor shall be responsible for restoring any damaged property to original condition and cleaning up the area in the vicinity of the damage or loss.

3.02 Preparation

A. Site Location Preparation

1. Work site as indicated on Plans shall be graded or filled to provide a level working area. No alterations beyond what is required for operations are to be made.
2. Contractor shall confine all activities to designated work areas.

3.03 ERECTION/INSTALLATION APPLICATION AND/OR CONSTRUCTION

A. Use equipment documented to be of sufficient size for the project to pull pipe. Use a suitable cutting head to bore face of excavation. Minimize overcut of excavation.

1. Annular space around pipe to be kept to a minimum to avoid surface settlement.
2. Use method that allows for removal of a volume of earth and fluid mixture, on a unit foot basis, that equals nominal volume of pipe, on a unit foot basis, being installed.
3. Do not leave unfilled reamed bore holes. Grout reamed bore holes not used for pipe placement with mixture approved by Project Manager.

B. Drill pipe at depth and grade shown on Plans.

C. Do not exceed a maximum distance shown on Plans for individual drilled segments unless otherwise approved by Project Manager prior to start of installation.

D. Continuously lubricate pipe with bentonite drilling fluid or other suitable techniques as approved by Project Manager.

- E. The maximum allowable pulling load exerted on the pipelines shall be measured continuously and be limited to 90 percent of the maximum allowed by the pipe manufacturer.
- F. Pipe may be filled with water to decrease buoyant forces and external hydrostatic force on the pipe.
- G. A swivel shall be used to connect the pipeline to the drill pipe to prevent torsional stresses from occurring in the pipe.
- H. Configure directional drilling rig such that tension in pipe during pull-back is uniformly distributed and shall not damage or permanently distort pipe.
- I. The Contractor shall handle pipe in a manner that does not over stress the pipe. Vertical and horizontal curves shall be limited so that wall stresses do not exceed 50 percent of yield stress for flexural bending of the pipe. If the pipe is buckled or otherwise damaged, the damaged section shall be removed and replaced by the Contractor at his expense.
- J. Once pull-back operations have commenced, the operation shall continue without interruption until the pipe is completely pulled through the bore hole.
- K. Use end cap while pulling pipe.
- L. Install relief pits as approved by Project Manager. Locate relief pits to agree with traffic control plan. No separate payment for pavement removal and replacement for relief pits.
- M. Size drilling and relief pits to provide adequate room to meet operational requirements for horizontal drilling requirements as well as structures indicated on Plans. Provide minimum 6-inch space between pipe and walls of drilling and relief pits. Maximum allowable width of drilling and relief pits shall be 5 feet. Width of pit at surface shall not be less than at bottom. Maximum allowable length of drilling pit shall be no more than 5 feet longer than one full section of pipe and shall not exceed 25 feet. Maximum allowable length of relief pit shall be 5 feet.
- N. Do not install drilling and relief pits at street intersections between curb returns.
- O. Replace sidewalks, driveways and pavement removed for relief pits according to Section 02951- "Pavement Repair and Resurfacing".
- P. Provide tees and plugs installed in piping subject to internal hydrostatic heads with suitable reaction blocking, anchors, joint harnesses, or other acceptable means of preventing movement of the pipe caused by internal pressure. Extend concrete blocking from fitting to undisturbed earth. Install blocking so joints are accessible for repair.

- Q. Backfill and compact excavations, including relief pits, in accordance with Specification Section 02317 – “Excavation and Backfill for Utilities”.
- R. Traffic Control
- Conform to applicable provisions of Section 01555 – “Traffic Control and Regulation”.
- S. Pipe Location Tolerance
1. Continuously monitor actual location of pipe with respect to proposed line and grade. Use steering head or other suitable method to control line and grade of pipe to within 6 inches of proposed line and 3 inches of the proposed grade.
 2. Continually monitor downhole probe location with magnetic guidance system. Establish a surface locating system to provide a backup and independent determination of pipeline location. System to be comparable to Sharewell’s TruTrack System or approved equal.
 3. Excavation to locate drilling head at exit point may occur provided no excavation is conducted or occurs within wetlands, submerged lands, street intersections, railroad crossings, or other similar areas.
 4. Keep Project Manager informed of and allow to monitor drilling progress and pipe location.
- T. Drilling Fluids and Excavated Materials
1. Contain drilling fluids and cuttings within designated limits of construction.
 2. Properly meter water that is used.
 3. Use biodegradable fluid additives which are environmentally safe.
 4. Dispose of excess fluids, cuttings, and other materials in accordance with governing regulations. Do not allow fluids to enter wetland area, body of water, sanitary or storm sewer systems.
 5. The Project Representative shall document all drilling fluid products used, the Contractor’s pumping pressures, rates, and details relative to drilling fluid circulation at the HDD endpoints.
 6. The right-of-way and surrounding areas shall be examined regularly for inadvertent returns.

- a. If inadvertent returns are discovered, contain and clean up in accordance with Specifications, permits and the Contractor's drilling fluid management plan. Locations shall be monitored for continuing problems.
7. Remove soil in accordance with Section 01576 – "Waste Material Disposal".
- 3.04 REPAIR/RESTORATION
- A. Damaged or Improperly Installed Pipe
 1. Replace pipe that is damaged or does not meet the Specifications.
 2. Unless otherwise approved by Project Manager, abandon in place pipe damaged during installation or placed at improper line or grade. After abandoning pipe, make alternative construction installation as approved by Project Manager.
 3. Excavate to determine obstacle when pipe cannot be advanced due to unforeseen obstruction. Offset pipe alignment, as approved by Project Manager, to avoid obstruction.

3.05 – 3.07 NOT USED

3.08 DEMONSTRATION / TESTING AND INSPECTION

- A. Hydrostatic Testing and Leakage Testing for Pressure Piping
 1. The entire pull section shall be subjected to a hydrostatic test prior to being installed in the hole. The test pressure shall be equal to or exceed that required for final certification. The hydrostatic pretest shall be conducted and documented in accordance with Section 02515 – "Hydrostatic Testing of Pipelines".
 2. In preparation for final pressure testing the following parameters must be followed:
 - a. All air must be vented from the pipeline prior to pressurization. Venting may also be accomplished by 'flushing' the pipeline.
 - b. The pipeline must be fully restrained prior to pressurization. This includes complete installation of all mechanical restraints per the restraint manufacturer's guidelines, whether permanent or temporary to the final installation. This also includes the installation and curing of any and all required thrust blocking. All appurtenances included in the pressure test, including valves, blow-offs, and air-relief valves shall be checked for proper installation and restraint prior to beginning the test.

B. Disinfection of the Pipeline for Potable Water Piping

1. Conform to requirements of Section 02514 – “Disinfection of Water Lines”.

3.09 – 3.10 NOT USED

END OF SECTION