

ITEM W18

HORIZONTAL DIRECTIONAL DRILL INSTALLATION

1.0 DESCRIPTION. This specification covers the requirements for furnishing all labor, equipment, and materials associated with the installation of watermain pipe by horizontal directional drilling method. The watermain pipe may be fusible PVC pipe or restrained joint ductile iron pipe as specified herein.

2.0 SUBMITTALS. The contractor shall submit the following information:

A. Reference Standards. This section is not applicable.

B. Shop Drawings.

1. All shop drawings submitted electronically for review and approval shall be returned within two weeks either approved or marked up for further design.
2. After examination of such drawings by the Engineer and the return thereof, the Contractor shall make such correction to the shop drawings as have been indicated and shall furnish the Engineer with electronic corrections.
3. Shop drawings shall be complete in details and indicate all materials as specified herein.
4. Manufacturer's catalog or general web-site information will not be sufficient to fulfill shop-drawing requirements.
5. Pipe and appurtenances:
 - a. Refer to material specifications W11, Ductile Iron Pipe and Fittings, or W14-PVC Pipe, for applicable items.
6. Prior to beginning work, the Contractor must submit to the Engineer a general Work Plan outlining the procedure and schedule to be used to execute the project.
 - a. The Plan should document the thoughtful planning required to successfully complete the project.
7. The Contractor shall submit specifications on directional drilling equipment to be used to ensure that the equipment will be adequate to complete the project.

C. Calculations. This section is not applicable.

D. Certifications.

1. The following qualifications shall have been met by the Directional Drilling Contractor for approval to perform any services on this Contract:
 - a. Directional drilling Contractor shall have actively engaged in the installation of pipe using on-grade boring for a minimum of five (5) years.
 - b. The Contractor shall submit three (3) reference projects of equal or similar size in which they have performed HDD installations of similar pipe diameter and overall length as specified herein, within the last five (5) years.

- c. The following evidence of qualification shall be submitted with the Bid and shall be owners only and include the following information:
 - i. Description of project (including project size).
 - ii. Location of project.
 - iii. Point of contact for each project.
 - iv. Telephone number of contact.
 - v. Project costs, start and completion dates.
- d. Field supervisory personnel employed by the directional drilling contractor shall have at least five (5) years' experience in the performance of the work. Qualifications shall be submitted with Bid.
- e. The County reserves the right to require an on-site representative of the directional drilling equipment manufacturer and/or a representative of the drilling fluids manufacturer, knowledgeable in the use of the product(s), for a minimum of two (2) working hours per workday (10 days maximum).
 - i. The cost for the on-site representative(s) will be paid by the Contractor.

3.0 MATERIALS. Only materials approved by the Stark County Metropolitan Sewer District may be used for this project.

A. Pipe and Appurtenances.

- 1. Ductile iron pipe shall follow Item W11- Ductile Iron Pipe and Fittings.
- 2. PVC pipe shall follow Item W14- PVC Pipe.

4.0 EXECUTION. The Contractor shall provide all labor, materials, equipment, and tools necessary to provide and install the water main as shown on all detailed Drawings and specified as below.

A. Fusion Process and Equipment. Refer to Item W14- PVC Pipe.

B. Construction Equipment.

- 1. General.
 - a. As a minimum, the directional drilling equipment shall consist of a directional drilling rig of sufficient capacity to perform the bore and pullback, a drilling fluid mixing, delivery and recovery system of sufficient capacity to successfully complete the bore, a guidance system to accurately guide boring operations, a vacuum truck of sufficient capacity to handle the drilling fluid volume, personnel meeting the training requirements, and all other equipment required to complete the installation.
 - b. The Contractor has the option of using a drilling fluid recycling system capable of removing solids from the drilling fluid so that the fluid can be re-used.
 - c. Prior to delivery to the site, all drilling equipment shall be serviced, inspected for damage and repaired as necessary.
 - d. The equipment shall be in good, safe operating condition.

2. Drilling System.

a. Drilling Rig:

- i. The directional drilling machine shall consist of a hydraulically powered system to rotate, push, and pull hollow drive pipe into the ground at a variable angle while delivering a pressurized fluid mixture to a guidable drill (bore) head.
- ii. The machine shall be anchored to the ground to withstand the pulling, pushing and rotating pressure required to complete the bore. The hydraulic power system shall be self-contained with sufficient pressure and volume to power drilling operations.
- iii. Hydraulic system shall be free of leaks.
- iv. Rig shall have a system to monitor and record maximum pull-back pressure during pull-back operations.
 - a) The Contractor shall record this information and provide a copy to the Engineer.
- v. The rig shall be grounded during drilling and pull-back operations.
 - a) There shall be a system to detect electrical current from the drilling string and an audible alarm which automatically sounds when an electrical current is detected.
- b. Drill Head: The drill head shall be steerable by changing its rotation and shall provide the necessary cutting surfaces and drilling fluid jets.
- c. Mud or Mechanical Motors (if required): Mud or Mechanical motors shall be of adequate power to turn the required drilling tools.
- d. Drill Pipe: The Contractor shall supply to the Engineer the drilling rig pipe material information including bending radius, performance characteristics, rig compatibility, etc.

3. Guidance System.

- a. A magnetic guidance system (MGS), grade beacon or proven gyroscopic system shall be used to provide a continuous and accurate determination of the location of the drill head during the drilling operation.
- b. The directional drilling guidance system shall have the capability of measuring vertical and horizontal positions and roll.
 - i. The system shall obtain an accuracy range within one-inch of the actual position of the drilling head.
 - ii. It shall enable the driller to guide the drill head by providing immediate information on the tool face, azimuth (horizontal direction) and inclination (vertical direction).
- c. The Contractor shall compute the position in the X, Y, and Z axis relative to the ground surface a minimum of every 1 foot.
 - i. Ground surface elevation shall be based on surveyed field conditions.
- d. The guidance system shall be of a proven type and shall be operated by personnel trained and experienced with the system.
- e. The Contractor shall demonstrate a viable method to eliminate error.
 - i. Contractor shall submit calibration results showing that the equipment is within tolerance.

- ii. The Contractor shall follow the manufacturer's recommended calibration sequence and calibration time schedule.
- f. The guidance system shall be capable of generating a plot of the bore hole survey for the purpose of an as-built drawing.
- g. Contractor shall use a locating and tracking system capable of ensuring that the proposed horizontal and vertical alignment is installed as intended.
- 4. Drilling Fluid System.
 - a. Mixing System:
 - i. A self-contained, closed, drilling fluid mixing system shall be of sufficient size to mix and deliver drilling fluid.
 - ii. Mixing system shall continually agitate the drilling fluid during drilling operations.
 - b. Drilling Fluid:
 - i. The Contractor shall use a drilling fluid suitable for the soil conditions as they exist for the project.
 - ii. The Contractor shall fully determine the soil conditions prior to fluid selection (be it from additional geotechnical investigation, exposing utilities, digging a slurry catch pit or other method).
 - iii. This decision shall include product concentrations and additives.
 - c. Delivery System:
 - i. The drilling fluid pumping system shall have a capacity to provide an adequate flow rate and pressure to facilitate the HDD operation as defined in the construction documents.
 - ii. The delivery system shall have filters in-line to prevent solids from being pumped into the drill pipe.
 - iii. Connections between the pump and drill pipe shall be leak-free.
 - iv. Used drilling fluid and drilling fluid spilled during drilling operations shall be contained and conveyed to the drilling fluid recycling system (if used).
 - v. A berm, minimum of 12" high, shall be maintained around drill rigs, drilling fluid mixing system, entry and exit pits, and drilling fluid recycling system to prevent spills into the surrounding environment.
 - vi. Pumps and or vacuum trucks of sufficient size shall be in place to convey excess drilling fluid from containment areas to storage and recycling facilities.
 - d. Drilling Fluid Recycling System:
 - i. If the Contractor chooses to use a drilling fluid recycling system, the system shall separate sand, dirt and other solids from the drilling fluid to render the drilling fluid re-usable.
 - ii. Spoils separated from the drilling fluid will be stored in a suitable location, as approved by the Engineer, for later use or disposal.
- 5. Pipe Rollers.
 - a. If required, shall be of sufficient size to fully support the weight of the pipe while being hydro tested and during pullback operations.
 - b. Sufficient number of rollers shall be used to prevent excess sagging of pipe.
 - c. The pipe shall not be dragged across the surface.

6. Pullback.
 - a. Contractor shall use breakaway swivel or mechanical “weak link” to prevent overstressing of the pipe.
7. Pipe Rammers.
 - a. Hydraulic or pneumatic pipe rammers may only be used if necessary and with the authorization of Engineer.
8. Restrictions.
 - a. Other devices or utility placement systems for providing horizontal thrust other than those previously defined in the preceding sections shall not be used unless approved by the Engineer prior to commencement of the work.
 - b. Consideration for approval will be made on an individual basis for each specified location.
 - c. The proposed device or system will be evaluated prior to approval or rejection on its potential ability to complete the utility placement satisfactorily without undue stoppage and to maintain line and grade within the tolerances prescribed by the particular conditions of the project.

C. Construction Procedures.

1. Site Preparation.
 - a. Work site as indicated on Drawings, within right-of-way, shall be graded or filled to provide a level working area.
 - b. No alterations beyond what is required for operations are to be made.
 - c. Contractor shall confine all activities to designated work areas.
 - d. The Contractor shall be responsible for provision and restoration of all required bore and receiving pits.
2. Environmental Protection.
 - a. Contractor shall place silt fence between all drilling operations and any drainage, wetland, waterway, or other area designated for such protection by contract documents, state, federal and local regulations.
 - b. Additional environmental protection necessary to contain any hydraulic or drilling fluid spills shall be put in place, including berms, liners, turbidity curtains and other measures.
 - c. Contractor shall adhere to all applicable environmental regulations.
 - d. Fuel or oil may not be stored in bulk containers within 200' of any water body or wetland.
3. Safety.
 - a. Contractor shall adhere to all applicable state, federal and local safety regulations and all operations shall be conducted in a safe manner.
 - b. Safety meetings shall be conducted at least weekly with a written record of attendance and topic submitted to Engineer.
4. Pilot Hole.
 - a. The Contractor shall follow the pipeline alignment as shown on the Drawings, within the specified tolerances.
 - b. There shall be no grade or deflection adjustments above the maximum 1% or 1" respectively.

- c. If adjustments are required, below this requirement the Contractor shall notify the Engineer for approval prior to making the adjustments.
 - d. In the event of difficulties at any time during HDD operations requiring the complete withdrawal from the bore, the Contractor may be allowed to withdraw and abandon the bore and begin a second attempt at a location approved by the Engineer.
 - e. In the event that a drilling fluid fracture, inadvertent returns or returns loss occurs during pilot hole drilling operations, contractor shall cease drilling, wait at least 30 minutes, inject a quantity of drilling fluid with a viscosity exceeding 120 seconds as measured by a Marsh funnel and then wait another 30 minutes.
 - i. If mud fracture or returns loss continues, contractor will cease operations and notify Engineer.
 - ii. Engineer and contractor will discuss additional options and work will then proceed accordingly.
 - f. Establish an entry angle hole so that the curvature of the pilot hole does not exceed the allowable bending radius of the pipe.
 - g. Sags in the watermain pipe shall not exceed 8% or 1" (whichever is greater) of nominal pipe diameter.
 - i. Sags will only be allowed where the entering and exiting grades are adequate to provide velocities through the sag area sufficient for moving solids.
 - ii. No more than one sag area shall occur between two manholes.
 - iii. The Engineer must approve the alignment of the bore before pipe can be pulled.
 - iv. If the pilot bore fails to conform to the above tolerances, the Engineer may require a new pilot boring be made.
 - h. At completion of the pilot hole drilling, provide Engineer tabulations of the horizontal and vertical alignment at minimum, intervals of 10 feet.
 - i. Also provide the horizontal distance from the centerline of the pilot hole to the edge of pavement.
5. Pipe Installation.
- a. Horizontally directional drilled pipe shall be installed in accordance with the instruction of the manufacturer, as shown on the Drawings and as specified herein.
 - b. Care shall be taken in loading, transporting and unloading to prevent injury to the pipe. Pipe or fittings shall not be dropped. All pipe or fittings shall be examined before installation, and no piece shall be installed which is found to be defective.
 - c. Any damage to the pipe shall be repaired as directed by the Engineer. If any defective pipe is discovered after it has been installed, it shall be removed and replaced with a sound pipe in a satisfactory manner by the contractor, at his own expense.
 - d. 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.

- e. After the pilot hole is completed, the Contractor shall enlarge the hole by pre-reaming (as needed) and install a swivel to the reamer and commence pullback operations.
 - f. Contractor will ream bore hole to a minimum size necessary to safely and properly install the pipe.
 - i. The annular space on the final bore hole shall not exceed 3-inches measured from the outside diameter of the host pipe.
 - g. The pipe being pulled into the bore shall be protected and supported by rollers so that it moves freely and is not damaged by debris on the ground during installation.
 - i. The pipe may not be dragged across the ground surface.
 - h. Pullback forces shall not exceed the allowable pulling forces for the product pipe.
 - i. The Contractor shall allow sufficient lengths of pipe to extend past the termination point (4" minimum) to allow connections to adjacent pipe sections or fittings.
 - i. The length of extra product pipe shall be at the Contractor's discretion.
6. Drilling Fluid.
- a. Disposal of excess drilling fluid and spoils will be the responsibility of the Contractor who shall comply with all relevant regulations, right-of-way, work space, and permit agreements. Excess drilling fluid and spoils shall be disposed of properly.
 - b. The Contractor is responsible for transporting all excess drilling fluid and spoils to the disposal site and paying any disposal costs.
 - i. Excess drilling fluid and spoils shall be transported in a manner that prevents accidental spillage onto roadways.
 - ii. Excess drilling fluid and spoils shall not be discharged into sanitary or storm systems, ditches or waterways.
 - c. Drilling fluid returns (caused by fracturing of formations) at locations other than the entry and exit points shall be minimized.
 - i. The Contractor shall immediately clean up any drilling fluid that inadvertently surfaces.
 - d. The Contractor shall be responsible for all fees and provisions for a clean water supply for mixing of drilling fluid.
7. Connection to Other Water Mains or Fittings.
- a. Pipe shall be connected to other watermains or fittings to provide a leak-free system.
 - b. Such connections shall follow Item W15- Open-Cut Pipe Installation.
8. Tracer Wire Installation.
- a. Installation of the tracer wire shall be such that it allows for proper access for connecting tracer equipment and proper locating of wire without loss or deterioration of the low frequency (512Hz) signal for distances in excess of 1,000 linear feet, without distortion of signal caused by multiple wires installed in close proximity to one another.

- b. The tracer wire and duplicate tracer wire shall be affixed to the top and side of the pipe respectively to assure proper placement and operation during and after the boring operation.
 - c. The wire shall be laid flat against the pipe and secured with a non-adhesive water proof silicone tape or tied to the pipe at a maximum of five (5') intervals.
 - d. No looping or coiling of the tracer wire shall be permitted.
 - e. All wire, connectors, terminations and access points, splicing, grounding, installation, and testing practices shall be submitted to the engineer for approval.
9. Polyethylene Encasement Installation.
- a. Contractor shall remove all lumps of clay, mud, cinders, etc. on the pipe surface before installation of the polyethylene encasement.
 - b. During installation, soil or embedment material shall not be trapped between the pipe and the polyethylene.
 - c. Sufficient slack shall be provided in contouring to prevent stretching the polyethylene where it bridges irregular surfaces, such as bell-spigot interfaces, bolted joints, or fittings and to prevent damage to the polyethylene caused by backfilling operations.
 - i. Overlaps shall be secured with adhesive tape.
 - d. The initial length of pipe will require the polyethylene tube to be securely attached to the spigot end of the pipe barrel using an appropriate tape.
 - i. The tape should be applied directly, attaching the polyethylene to the barrel of the pipe.
 - ii. Several circumferential wraps of tape should be provided to secure the encasement along the length of pipe.
 - iii. This will help control any tendency for drilling fluids or cuttings to get under the polyethylene tube.
 - iv. When applying polyethylene encasement to the assembled joint, the polyethylene overlap should be placed so that the forward pipe's polyethylene tube overlaps the polyethylene installed on the next adjacent pipe.
 - v. This is to ensure that drilling fluid and cuttings are not forced under the polyethylene tube during the pull-back.
 - e. Installation on ductile iron pipes shall be in accordance with methods A or B as specified in AWWA-C105 and below:
 - i. Method A:
 - a) Cut polyethylene tube to a length approximately 2 feet longer than the pipe section.
 - b) Slip the tube around the pipe, centering it to provide 1-foot overlay on each adjacent pipe section and bunching it accordion-fashion lengthwise until it clears the pipe ends.
 - c) Lower the pipe into the trench and make up the pipe joint with the preceding section of pipe.
 - d) A shallow bell hole must be made at the joints to facilitate installation of the polyethylene tube.

- e) After assembling the pipe joint, make the overlap of the polyethylene tube.
- f) Pull the bunched polyethylene from the preceding length of pipe, slip it over the length of the new length of pipe, and secure it in place.
- g) Then slip the end of the polyethylene from the new pipe section over the end of the first wrap until it overlaps the joint at the end of the preceding length of pipe.
- h) Secure the overlap in place.
- i) Take up the slack along the barrel of the pipe, securing the fold at quarter points.
- j) Proceed to the next section of pipe in the same manner.
- ii. Method B:
 - a) Cut polyethylene tube to a length approximately 1 foot shorter than that of the pipe section.
 - b) Slip the tube around the pipe, centering it to provide 6-inch of bare pipe at each end.
 - c) Take up the slack width at the top to the pipe for a snug but not tight fit along the barrel of the pipe securing the fold at quarter points.
 - d) Secure the ends with polyethylene tape.
 - e) Before making up a joint, slip a 3-foot length of polyethylene tube over the end of the preceding pipe section, bunching it accordion-fashion lengthwise.
 - f) Alternatively, place a 3-foot length of polyethylene sheet in the trench under the joint to be made.
 - g) After completing the joint, pull the 3-foot length of polyethylene over or around the joint, overlapping the polyethylene previously installed on each adjacent section of pipe by at least 1-foot.
 - h) Make each end snug and secure with polyethylene tape.
 - i) A shallow bell hole is necessary and shall be made at joints to facilitate the installation of the polyethylene tube or sheet.
- f. Care shall be taken when installing backfill to prevent damage to the wrapping.
- g. Repair cuts, tears, punctures, or damage to polyethylene with adhesive tape or with a short length of polyethylene sheet, or with a tube cut open, wrapped around the pipe to cover the damaged area, and secured in place.

D. Construction Notifications.

1. The Engineer must be notified 48 hours in advance of starting work.
2. The Directional Drilling shall not begin until the Engineer is present at the job site and agrees that proper preparations for the operation have been made.
3. The Engineer approval for beginning the installation shall in no way relieve the Contractor of the ultimate responsibility for the satisfactory completion of the work as authorized under the Contract.
4. It shall be the responsibility of Engineer to provide inspection personnel at such times as appropriate without causing undue hardship by reason of delay to the Contractor.

E. Construction Tolerances:

1. The tie-in elevations shown for the beginning and ending of the HDD work of the project must meet the elevations shown on the plans.
2. The ends of the pipe shall be located (horizontally and vertically) such that the directional drilled pipe installed according to this specification can be tied to other segments of water line without negative slopes or sags.
3. The Engineer reserves the right to reject pipes installed not meeting the tolerance requirements specified herein.
 - a. It will be the responsibility of the Contractor to replace rejected work with pipe meeting these requirements.
 - b. No additional compensation shall be provided to the Contractor for replacement of pipe not meeting tolerance requirements.
4. Contractor shall have a representative who is thoroughly knowledgeable of the equipment and HDD procedures present at the job site during the entire installation and available to address immediate concerns and emergency operations.
5. The Engineer must be notified immediately if any condition is encountered that stops the forward progress of drilling operations.
 - a. When it is determined that it is impossible to continue drilling operations, the Contractor shall determine the best course of action.
 - b. The Contractor may be allowed to abandon the completed portion in place and start a new hole as directed by the Engineer at no additional cost to the County.
6. Contractor shall take responsibility for the restoration of any damage caused by heaving, settlement, separation of pavement, escaping drilling fluid, or the directional drilling operation, at no cost to the County.
7. The installation of the water pipe into the bore hole shall be on the same day that the bore is completed to ensure the necessary support exists.
8. The required piping shall be assembled in a manner that minimizes the obstruction of adjacent roadways, driveways or public activities.
 - a. The Contractor shall erect temporary fencing around entry and exit pipes staging areas as needed.
 - b. The Contractor staging areas shall be as approved by the Engineer.
9. The Contractor is responsible for obtaining all necessary permits.
 - a. Copies of each permit shall be available to the Engineer at the work site.

F. Cleaning, Site Restoration, and Inspection.

1. Following drilling operations, contractor will demobilize equipment and restore the worksite to original condition.
2. All excavations will be backfilled and compacted to 95% of original density.
3. Landscaping will be restored to original.
4. All mud shall be disposed of by the Contractor.
5. The Contractor is required to maintain the work site in a neat and orderly condition throughout the period of work and after completing the work at each

site, remove debris, surplus material and temporary structures erected by the Contractor.

6. Upon completion of work, the site must be restored to its former condition.

G. Horizontal Directional Drilling Contingency Plan.

1. A Horizontal Directional Drilling (HDD) Contingency Plan (Plan) must be developed and incorporated in the work plan prepared for the project.
2. The HDD Plan must be implemented as a condition of this project specification in the event HDD is anticipated for the construction and installation of water mains.
3. A copy of the HDD Plan must be on-site and available for review at each location where drilling will occur.
4. The Plan, at a minimum, must include the following sections with stated basic elements:
 - a. Introduction
 - b. Planned HDD Crossings
 - c. Site Specific Information
 - d. Monitoring Procedures
 - e. Notification Procedures
 - f. Corrective Actions
 - g. Best Management Practices (BMP's)
 - h. Alternate Contingency Plan
 - i. Drilling Fluid Additives and Lost Circulation Materials (LCM's)
 - j. Disposal Considerations for Drilling Fluids and Drill Cuttings
5. The Contractor shall follow the guidelines in Appendix 'A' of this Item.

5.0 ELECTRICAL. This section is not applicable.

6.0 QUALITY ASSURANCE. The work covered under this section of the Specification is intended to be the work, materials, labor, and equipment required to install the water main as described above. All material used on this project shall be new and unused unless otherwise specified and all workmanship shall be of the best quality. Only qualified and skilled workmen/women shall be employed for all phases of this project. All workmen/women shall be trained in trench safety.

A. Testing.

1. Refer to Item W-34- Water Line Construction, for testing and disinfection requirements.
2. Upon completion of installation, the trace wire system shall be tested for system integrity.
 - a. Continuity testing in lieu of actual line testing shall not be allowed.
 - b. Contractor shall be responsible to repair or replace any system failures discovered at this time at no additional cost to the County.

B. Observation.

1. SCMSD designated representative will visually observe the work performed. The representative will notify the Engineer of any discrepancies with the contract documents in the course of the contractor performing the work. The progress observations by the SCMSD do not waive any rights or remedies, nor divest the Contractor of any responsibility for contract compliance or liability for damage.
2. The Contractor shall maintain a daily project log of drilling operations and a guidance system log with a copy given to the Engineer at completion of the project.
 - a. As-built drawings shall be certified as to accuracy by the Engineer.

C. Warranty.

1. Refer to Item W34- Water Line Construction, for warranty requirements.
2. Tracer wire manufacturer shall provide a five (5) year corrosion resistant study or a three (3) year material and replacement warranty.

7.0 MEASUREMENT. This section is not applicable.

8.0 PAYMENT. The cost for all labor, equipment, tools and other incidental items stipulated herein shall be included in the pipe material items.

END OF SECTION