

Item No. 502
Utility Horizontal Directional Drilling

502.1 Description

This item shall govern furnishing and installing underground water and sewer force main line using the horizontal directional drilling (HDD) method of installation. This item shall include all services, equipment, materials, and labor for the complete and proper installation, testing, restoration of underground utilities and erosion and sedimentation control and restoration.

502.2 Quality Assurance

The requirements set forth in this document specify a wide range of procedural precautions necessary to provide the very basic, essential aspects of a proper HDD installation and ensure they are adequately controlled. Strict adherence shall be required under specifically covered conditions outlined in this Section. Adherence to the specifications contained herein, or the Owner's Representative approval of any aspect of any HDD operation covered by this Section, shall in no way relieve the Contractor of their ultimate responsibility for the satisfactory completion of the Work authorized under the Contract.

A. Installer's Qualifications

Installation shall be by a competent, experienced contractor or subcontractor. The installation contractor shall have a satisfactory experience record of at least 10 years engaged in similar work of equal scope. If patented processes are involved based on the pipe selection, the Installer shall be licensed, trained and in good standing with the pipe Manufacturer.

B. Performance Requirements

Lateral or vertical variation in the final position of the carrier pipe from the line and grade established by the Drawings shall be limited to 4 percent, provided that such variation shall be regular and only in the direction that will not detrimentally affect the function of the carrier pipe. Vertical deflections for sewer lines may be permitted as long as the slope is continuous (no sags), meets Texas Commission on Environmental Quality minimum slope requirements, and will flow by gravity with no surcharge and into existing or proposed downstream improvements.

C. Certification

Pipe products shall have been tested and approved by an independent third-party laboratory for continuous use at rated pressures. Pipe and couplings intended for contact with potable water shall be evaluated, tested, and certified for conformance with NSF Standard 61 by an acceptable certifying organization.

D. Design Criteria

The maximum allowable load for PVC pipe installations shall produce a maximum deflection of 4 percent. The maximum allowable load for HDPE piping used for sanitary sewer shall produce a maximum long term 50-year deflection of 4.2 percent.

502.3 SUBMITTALS**A. Work Plan**

Prior to beginning the Work, the Contractor shall submit to the Owner's Representative a work plan as Record Data detailing the procedure and schedule to be used to execute the Project. The work plan should include a description of all equipment to be used, down-hole tools, a list of personnel and their qualifications and experience (including back-up personnel in the event that an individual is unavailable), list of Subcontractors, a schedule of work activity, a safety plan (including MSDS of any potentially hazardous substances to be used), traffic control plan (if applicable), all excavation locations, interfering utilities, and flow bypass, an erosion and sedimentation control plan and contingency plans for possible problems. Work plan should be comprehensive, realistic and based on actual working conditions for the Project. Contractor shall provide calculations following the criteria set forth in section 502.4, Paragraph D. Calculations provided should be, but not limited to bend stress calculations, bending strain, pull loads, breakaway link settings, max pressure during pull back, critical collapse pressure, and safety factor against collapse. Contractor shall provide a detailed summary of all assumptions and calculations that follow the design criteria requirement set forth in section 502.4, Paragraph D.

B. Equipment

Contractor will submit specifications on directional drilling equipment as Record Data. Equipment shall include but not be limited to: drilling rig, butt fusion welding apparatus, mud system, mud motors (if applicable), down-hole tools, guidance system, rig safety systems. Calibration records for guidance equipment shall be included. Specifications for any drilling fluid additives that Contractor intends to use or might use will be submitted.

C. Material

Provide Shop Drawings of the pipe with material specifications, including size, type, diameter and Manufacturer's data and certifications on piping and jointing methods. The shop drawing shall include a Certificate of Adequacy of Design stating the pipe and fittings are satisfactory for the loads which will be imposed during for all loading conditions.

D. Logs

Contractor shall maintain a daily written project log of drilling operations and a guidance system log along with a fusion data log report for all butt fused welding of joints with a copy given to Owner's Representative at completion of the Project.

502.4 Standards

The applicable provisions of the following standards shall apply as if written here in their entirety:

A. American National Standards Institute (ANSI) / NSF Standards:

ANSI/NSF 61	Drinking Water System Components – Health Effects
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B. ASTM International (ASTM) Standards:

ASTM D1248	Specification for Polyethylene Plastics Molding and Extrusion Materials
ASTM D2241	Standard Specification for Poly (Vinyl Chloride) PVC Pressure Rated Pipe
ASTM D3034	Standard Specification for type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D1784	Standard Specification for Rigid PVC Compounds and Chlorinated PVC Compounds
ASTM D2837	Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials
ASTM D3139	Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D3261	Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
ASTM D3350	Specification for Polyethylene Plastics Pipe and Fittings Material
ASTM F477	Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pressure Pipe
ASTM F714	Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
ASTM F1804	Standard Practice for Determining Allowable Tensile Load for Polyethylene (PE) Gas Pipe During Pull-In Installation
ASTM F1962	Standard Guide for Use of Maxi-Horizontal Directional Drilling for Placement of Polyethylene Pipe or Conduit under Obstacles, Including River Crossings

C. American Water Works Associations (AWWA) Standards:

AWWA C901	Standard Specification for Polyethylene (PE) Pressure Pipe and Tubing, 3/4 inch through 3 inches, for Water Service
AWWA C900	Standard Specification for PVC Pressure Pipe and Fabricated Fittings, 4 inch through 60 inches
AWWA C906	Standard for Polyethylene (PE) Pressure Pipe and Fittings, 4 inch through 65 inches, for Waterworks

D. Design Standards

1. Pipeline Research Committee International (PRCI): PR-277-144507-Z01 Installation of Pipelines by Horizontal Directional Drilling Engineering Design Guide
2. North American Society for Trenchless Technology (NASTT): Horizontal Directional Drilling (HDD) Good Practices Guidelines
3. ASCE Pipeline Design for Installation by Horizontal Directional Drilling

E. Job Conditions; Permits and Easement Requirements

1. Where the Work is in the public right-of-way or railroad company right-of-way, the Owner will secure the appropriate permits or easements. The Contractor shall observe regulations and instructions of the right-of-way owner as to the methods of performing

the Work and take precautions for the safety of the property and the public. Negotiations and coordination with the right-of-way owner shall be carried on by the Contractor, not less than 5 days prior to the time of his intentions to begin Work on the right-of-way.

2. Comply with the requirements of the permit and/or easement. Work within the Texas Department of Transportation (TXDOT) right of way shall comply with TXDOT requirements. If required by the right-of-way owner, obtain Protective Liability Insurance in the amount required by the particular company or other insurance as is specified in the permit at no cost to the Owner. Acquire a permit, agreement, or work order from the right-of-way owner as is required.
3. Construction along roads, railroads and public areas shall be performed in such manner that does not interfere with the operations of the roads, driveways, sidewalks, pedestrian traffic and railroads.
4. Barricades, warning signs, and flagmen, when necessary and specified, shall be provided by the Contractor.
5. No blasting shall be allowed.
6. Existing pipelines and underground conduits are to be protected. The Contractor shall verify location and elevation of any pipe lines, telephone cable and fiber optics before proceeding with the construction and shall plan his construction so as to avoid damage to the existing pipe lines or telephone cables. Verification of location (vertical and horizontal) of existing utilities shall be the complete responsibility of the Contractor.

502.5 Materials

A. General

1. The directional drilling equipment shall consist of a directional drilling rig of sufficient capacity to perform the bore and pullback the pipe, a drilling fluid mixing, delivery and recovery system of sufficient capacity to successfully complete the crossing, a drilling fluid recycling system to remove solids from the drilling fluid so that the fluid can be re-used, a guidance system to accurately guide boring operations, a vacuum truck of sufficient capacity to handle the drilling fluid volume, trained and competent personnel to operate the system and meet the experience requirements set for in Section 502.2 A.
2. 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.

B. Drilling System

1. Drilling Rig: The directional drilling machine shall consist of a hydraulically powered system to rotate, push and pull hollow drill pipe into the ground at a variable angle while delivering a pressurized fluid mixture to a guidable drill (bore) head. The machine shall be anchored to the ground to withstand the pulling, pushing and rotating pressure required to complete the crossing. The hydraulic power system shall be self-contained with sufficient pressure and volume to power drilling operations. Hydraulic system shall be free of leaks. Rig shall have a system to monitor and record maximum pull-back pressure during pullback operations. The rig shall be grounded during drilling and pull-back operations. There shall be a system to detect electrical current from the drill string and an audible alarm which automatically sounds when an electrical current is detected.

2. Drill Head: The drill head shall be steerable by changing its rotation and shall provide the necessary cutting surfaces and drilling fluid jets.
3. Mud Motors (if required): Mud motors shall be of adequate power to turn the required drilling tools.
4. Drill Pipe: Shall be suitable for the anticipated torque, axial forces, and corresponding stresses expected during installation.

C. Guidance System

1. A Magnetic Guidance System (MGS) 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. The guidance shall be capable of tracking at all depths up to 100 feet and in any soil condition, including hard rock. 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). The guidance system shall be accurate to plus or minus 2 percent of the vertical depth of the bore hole at sensing position at depths up to 100 feet and accurate within 1.5 meters horizontally.
2. The Guidance System shall be of a proven type and shall be operated by personnel trained and experienced with this system. The Operator shall be aware of any magnetic anomalies on the surface of the drill path and shall consider such influences in the operation of the guidance system if using a magnetic system. Contractor shall provide documentation of guidance system calibration.

D. Drilling Fluid Mud System

1. Mixing System: A self-contained, closed, drilling fluid mixing system shall be of sufficient size to mix and deliver drilling fluid. The drilling fluid reservoir tank shall be of sufficient size for making the bore. Mixing system shall continually agitate the drilling fluid during drilling operations.
2. Drilling Fluids: Drilling fluid shall be composed of clean water and appropriate additives.
3. Delivery System: The mud pumping system shall have a minimum capacity to maintain correct boring alignment and be capable of delivering the drilling fluid at a constant pressure. The delivery system shall have filters in-line to prevent solids from being pumped into the drill pipe. Connections between the pump and drill pipe shall be relatively leak-free. Used drilling fluid and drilling fluid spilled during drilling operations shall be contained and conveyed to the drilling fluid recycling system. A berm, minimum of 12 inches 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. Pumps and or vacuum truck(s) of sufficient size shall be in place to convey excess drilling fluid from containment areas to storage and recycling facilities.
4. Drilling Fluid Recycling System: The drilling fluid recycling system shall separate sand, dirt and other solids from the drilling fluid to render the drilling fluid reusable. Spoils separated from the drilling fluid will be stockpiled for later use or disposal.

E. Other Equipment

1. Restrictions: 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. Consideration for

approval will be made on an individual basis for each specified location. 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.

F. Piping Materials

Note to Specifier: Engineer must select pressure class for water or sewer lines based on project conditions and working pressures.

1. Water Line Materials

- a. PVC Water Line Piping 4 through 60 inches shall be Fusible C900 [**CLASS 165 (DR-25)**] [**CLASS 235 (DR-18)**] [**CLASS 305 (DR-14)**] by Underground Solutions or approved equal. Three-inch water lines shall be Underground Solutions IPS Fusible PVC Schedule 80 or approved equal.
- b. Delivery and Storage
Store PVC pipe material so that there is no exposure to sunlight.
- c. HDPE Water Line Piping 4 through 30 inches shall be AWWA C906 with ductile iron sizing system (DIOD), PE4710 Materials, [**DR11 Pressure Class 160**] [**DR9 Pressure Class 200.**] HDPE water services 1 through 3 inches shall be AWWA C901 DR9 Pressure class 200.

2. Sewer Line Force Main Materials

- a. For pressure applications, PVC sewer line piping shall be Fusible PVC ASTM D2241 or Fusible AWWA C900 [**CLASS 165 (DR-25)**] [**CLASS 235 (DR-18)**] [**CLASS 305 (DR-14)**] by Underground Solutions.
- b. Polyethylene Plastic Pipe shall be high density polyethylene pipe and meet the applicable requirements of ASTM F714 Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter (Ductile Iron Pipe Sizing), ASTM D1248, and ASTM D3350, [**DR11 Pressure Class 160**] [**DR9 Pressure Class 200.**] All pipe shall be made of virgin material. No rework except that obtained from the manufacturer's own production of the same formulation shall be used. The pipe shall be homogenous throughout and shall be free of visible cracks, holes, foreign material, blisters or other deleterious faults.

3. Pipe Markings

Pipe shall be legibly marked in permanent ink with the manufacturer and trade name, nominal size and DR rating/pressure class, hydrostatic proof test pressure, NSF 61 if applicable, manufacturer date code. Pipe and couplings shall also bear the mark of the certifying agency which have tested and approved the product for use in fire protection applications.

4. Tracer Wire

All piping shall be installed with 10 gauge or thicker tracer wire per Item No. 512 "Tracer Wire."

502.6 Construction Methods

A. General

1. The Engineer and Owner's Representative must be notified 48 hours in advance of starting the Work. The Directional Bore shall not begin until a pre-bore profile has been approved by the Engineer, and the Owner's Representative is present at the Site and agrees that proper preparations for the operation have been made.
2. The 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. It shall be the responsibility of Owner's Representative to provide inspection personnel at such times as appropriate without causing undue hardship by reason of delay to the Contractor.

B. Personnel Requirements

1. All personnel shall be fully trained in their respective duties as part of the directional drilling crew and in safety. The operator of the drilling rig must have at least 3 years directional drilling experience. A responsible representative who is thoroughly familiar with the equipment and type work to be performed, must be in direct charge and control of the operation at all times. In all cases the supervisor must be continually present at the Site during the actual Directional Bore operation. The Contractor shall have a sufficient number of competent workers on the job at all times to ensure the Directional Bore is made in a timely and satisfactory manner. Contractor shall also maintain a written log of personnel working each day, and times they are on-site.

C. Drilling Procedures

1. Site Preparation: Prior to any alterations to work site, Contractor shall photograph or video tape entire work area, including entry and exit points, one copy of which shall be given to Owner's Representative and one copy to remain with Contractor for a period of 1 year following the completion of the Project. Work sites shall be within right-of-way and shall be graded or filled to provide a level working area. No alterations beyond what is required for operations are to be made. Contractor shall confine all activities to designated work areas.
2. Drill Path Survey: Entire drill path shall be accurately surveyed by the Contractor with entry and exit stakes placed in the appropriate locations per the design and located in the field with the Owner's Representative. Locate existing utilities in advance of boring operations. The Contractor shall be responsible for repairing damage to existing utilities at no additional cost to the Owner. Repair of existing utilities shall proceed until complete and the existing utility is back in service. If Contractor is using a magnetic guidance system, drill path will be surveyed by the Contractor for any surface magnetic variations or anomalies.
3. Environmental Protection: Contractor shall place silt fence and necessary BMPs between all drilling operations and any drainage, wetland, waterway or other area designated for such protection by Contract Documents, state, federal and local regulations. 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. Contractor shall adhere to all applicable environmental regulations. Fuel may not be stored in bulk containers within 200 feet of any water-body or wetland.

Contractor shall provide a plan in the event and inadvertent return occurs during the drilling operation. The plan shall include but not limited to, containment, clean up, and monitoring of inadvertent returns. In the event an inadvertent return or loss of circulation occurs, the contractor shall cease operations and notify Owner. Owner, Engineer, and Contractor will discuss additional options and work will then proceed accordingly.

4. Safety: Contractor shall adhere to all applicable state, federal and local safety regulations and all operations shall be conducted in a safe manner.
5. Pilot Hole:
 - a. Pilot hole shall be drilled on bore path with no deviations greater than 4 percent horizontally or vertically (water lines) over a length of 100 feet. In the event that pilot hole does deviate from bore path more than 4 percent, Contractor shall notify Owner’s Representative who may require Contractor to pull-back and re-drill from the location along bore path before the deviation. 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 March funnel and then wait another 30 minutes.
 - b. If mud fracture or returns loss continues, Contractor will cease operations and notify Owner’s Representative. Owner’s Representative and Contractor will discuss additional options and Work will then proceed accordingly.
6. Reaming: Upon successful completion of pilot hole, Contractor will ream bore hole to a minimum of 50 percent greater than outside diameter of pipe using the appropriate tools. Contractor will not attempt to ream at one time more than the drilling equipment and mud system are designed to safely handle.
7. Pull-Back:
 - a. After successfully reaming bore hole to the required diameter, Contractor will pull the pipe through the bore hole. In front of the pipe will be a swivel and reamer to compact bore hole walls. Pull loads shall not exceed the limits shown in the following tables, and Contractor shall provide the required pull forces set forth in Section 5.02, Paragraph D prior to pullback. Once pull-back operations have commenced, operations must continue without interruption until pipe is completely pulled into bore hole.

Table 1

HDPE Maximum Pull Loads (lb.) - ASTM F1804									
Nominal	OD	DR							
		7	9	11	13.5	15.5	17	21	26
4	4.8	9674	7803	6529	5418	4768	4374	3583	2922
6	6.9	19,990	16,123	13,492	11,197	9853	9038	7404	6037
8	9.05	34,388	27,737	23,209	19,262	16,949	15,548	12,736	10,386
10	11.1	51,731	41,726	34,915	28,976	25,498	23,389	19,160	15,624
12	13.2	73,157	59,007	49,376	40,977	36,058	33,077	27,095	22,095
16	17.4	127,118	102,531	85,796	71,202	62,655	57,474	47,081	38,392

18	19.5	159,653	128,773	107,755	89,426	78,691	72,184	59,131	48,219
20	21.6	195,891	158,003	132,213	109,724	96,553	88,569	72,552	59,163
24	25.8	279,478	225,422	188,628	156,543	137,751	126,361	103,510	84,408
30	32	429,940	346,783	290,180	240,821	211,913	194,390	159,237	129,851

Table 2

PVC Fusible PVC - Underground Solutions Maximum Pull Loads			
AWWA C900			
Size (in.)	DR	Minimum Radius (ft.)	Maximum Pull In Force (lb.)
4	18	100	10,600
6	18	144	21,900
8	18	189	37,800
10	18	231	56,800
12	18	275	80,300
4	14	100	13,400
6	14	144	27,700
8	14	189	47,700
10	14	231	71,800
12	14	275	101,600

Table 3

PVC Fusible PVC - Underground Solutions Maximum Pull Loads			
AWWA C900			
Size (in.)	DR	Minimum Radius (ft.)	Maximum Pull In Force (lb.)
14	25 (165 psi)	100	8700
16	25 (165 psi)	150	10,900
18	25 (165 psi)	200	17,200
20	25 (165 psi)	250	27,200
24	25 (165 psi)	300	31,500
30	25 (165 psi)	400	62,000
14	21 (200 psi)	319	93,400

PVC Fusible PVC - Underground Solutions Maximum Pull Loads			
AWWA C900			
Size (in.)	DR	Minimum Radius (ft.)	Maximum Pull In Force (lb.)
16	21 (200 psi)	363	120,800
18	21 (200 psi)	406	151,700
20	21 (200 psi)	450	186,100
24	21 (200 psi)	538	265,600
14	18 (235 psi)	319	108,000
16	18 (235 psi)	363	139,700
18	18 (235 psi)	406	175,400
20	18 (235 psi)	450	215,300
24	18 (235 psi)	538	307,100
30	17 (250psi)	319	5200
36	17 (250psi)	363	9000
6	17 (250psi)	406	15,000
8	17 (250psi)	450	17,200

Table 4

PVC Fusible PVC - Underground Solutions Maximum Pull Loads			
ASTM D2241 - Pressure Rated PVC			
Size (in.)	DR	Minimum Radius (ft.)	Maximum Pull In Force (lb.)
3	SCH. 80 (370 psi)	73	8400
4	SDR 26 (160 psi)	94	6400
6	SDR 26 (160 psi)	138	14,500
8	SDR 26 (160 psi)	180	24,000
10	SDR 26 (160 psi)	224	37,200
12	SDR 26 (160 psi)	266	52,800
14	SDR 26 (160 psi)	292	63,900
16	SDR 26 (160 psi)	333	83,800
18	SDR 26 (160 psi)	375	105,000
20	SDR 26 (160 psi)	417	130,200
24	SDR 26 (160 psi)	500	186,700

- b. During pull-back operations, Contractor will not apply more than the maximum safe pipe pull pressure at any time. Prior to pullback operations, Contractor shall provide pull force calculation and requirements for approval as set forth in Section 502.4, Paragraph D. In the event that pipe becomes stuck, Contractor will cease pulling operations to allow any potential hydro-lock to subside and will recommence pulling operations. If pipe remains stuck, Contractor will notify Owner's Representative to discuss options and then Work will proceed accordingly.

D. HDPE and Fusible PVC Pipe Joining

1. The pipe shall be assembled and joined at the Site using the thermal butt-fusion method to provide a leak proof joint. Threaded or solvent-cement joints and connections are not permitted. All equipment and procedures used shall be used in strict compliance with the manufacturer's recommendations. Fusing shall be accomplished by personnel certified as fusion technicians by a manufacturer of polyethylene pipe and/or fusing equipment.
2. The butt-fused joint shall be true alignment and shall have uniform roll-back beads resulting from the use of proper temperature and pressure. The joint shall be allowed adequate cooling time before removal of pressure. When cool, all weld beads shall then be removed from both the inside and outside surface such that the joint surfaces shall be smooth. The fused joint shall be watertight and shall have tensile strength equal to that of the pipe. All joints shall be subject to acceptance by the Owner's Representative prior to insertion. All defective joints shall be cut out and replaced at no cost to the Owner. Any section of the pipe with a gash, blister, abrasion, nick, scar or other deleterious fault greater in depth than 10 percent of the wall thickness, shall not be used and must be removed from the Site. However, a defective area of the pipe may be cut out and the joint fused in accordance with the procedures stated above. In addition, any section of pipe having other defects such as concentrated ridges, discoloration, excessive spot roughness, pitting, variable wall thickness or any other defect of manufacturing or handling as determined by the Owner's Representative shall be discarded and not used.
3. Terminal sections pipe that are joined within the insertion pit shall be connected with a full circle pipe repair clamp. The butt gap between pipe ends shall not exceed 1/2 inch.

E. Pipe Testing

1. Following successful pull-back of pipe, Contractor will test pipe using potable water according to Item 515, "Pipeline Testing & Acceptance." A calibrated pressure recorder will be used to record the pressure during the test period. This record will be presented to Owner's Representative.

F. Tracer Wire Testing

1. Upon completion the Contractor shall demonstrate that the wire is continuous and unbroken through the entire run of the pipe including full signal conductivity (including splices). If the wire is broken, the Contractor shall repair or replace it. Pipeline installation will not be accepted until the wire passes a continuity test.

G. Site Restoration

1. Following drilling operations, Contractor will de-mobilize equipment and restore the work site to original condition. All excavations will be backfilled and compacted to 95 percent

of original density. Landscaping will be subcontracted to a local professional landscaping company.

502.7 Measurement

Horizontal directional drilling will be measured by the linear foot from entry to exit point. Such measurement will be made between the ends of the pipe along the central axis as installed.

502.8 Payment

The work performed and materials furnished as prescribed by this item and measured as provided under "Measurement" will be paid for at the unit bid price per linear foot for "Utility Horizontal Directional Drilling," of type, size and class of HDD carrier pipe as indicated on the Drawings. The price shall include full compensation for furnishing, preparing, hauling and installing required materials, HDD carrier pipe, drilling rig, drilling fluids, labor, tools, equipment and incidentals necessary to complete work, including excavation, backfilling, cleanup and disposal of surplus material.

Payment when included as a contract pay item, will be made under the following:

Pay Item: HDD ___ In. Pipe, Class ___ Per Linear Foot

END