

## SECTION 505 – DIRECTIONAL BORING

### 1. GENERAL

Directional boring operations shall conform to the following specifications.

### 2. CONTRACTOR RESPONSIBILITIES.

The Contractor shall supply all labor, supervision, tools, equipment, and materials necessary to install HDPE, PVC or DIP (potable water only) by directional bore method. The items include the following:

- Tracer wire for carrier pipe
- Site preparation and excavation
- Dewatering
- Sheeting and shoring, as necessary
- All fusion welding, if required
- Site clean up including removal and disposal of drilling fluid
- Vacuum truck on job site for clean up of drilling fluid
- All fittings, and couplings
- Final site restoration (sod, seed, mulch, concrete/asphalt repair)
- Required Right-Of-Way Permits

The Contractor shall provide experienced operators to perform directional boring. The operator shall have performed at least three directional bores of similar pipe diameter and bore length.

The Contractor shall be fully responsible for placement of the pipe per the Utility Engineer's specifications.

The Contractor shall record data on a bore log and shall also ensure the following items are monitored and controlled:

- Calibrate locator/tracking system
- Field verify calibration by field measurement of actual location of first rod
- Ensure that the flow of bentonite is continuous
- Ensure pulling pressure does not exceed pipe manufacturer's specification
- Utilization of specified restrained joint PVC or DIP

The Contractor shall record location and depth measurements every ten (10) feet over the course of the bore and provide that data to the City. The Contractor shall log all necessary data from the locator tracking system:

Position  
Roll angle  
Tilt angle  
Depth every ten (10) feet  
Temperature of Data Transmitter  
Remaining Battery life  
Pull back force (record maximum pull back force)  
Drilling fluid pressure

The Contractor shall notify all involved agencies prior to start of construction. The Contractor is responsible for verifying that all permits are current and not expired.

The Contractor shall call Kansas One-Call and the City of Salina (785)826-7305 two full days prior to performing any excavation or boring.

The Contractor shall perform directional bore in accordance with the approved project plans or as directed and allowed by the Utility Engineer. In no case shall the bore extend into private property unless an easement is provided prior to start of construction. Vertical tolerances shall be plus or minus 0.5 foot of elevations shown on the drawings or as per City of Salina specifications. Horizontal tolerances shall be plus or minus 1 foot of horizontal alignment shown on drawings. Failure to meet tolerances, if not pre-approved by the Utility Engineer, may be grounds for rejecting the bore.

The Contractor shall provide all structures, safety equipment, and professional services required for the health and safety of the general public and of personnel involved in directional boring work in accordance with the requirements of the Federal, State, and Local Authorities.

The Contractor shall take all measures necessary to protect surrounding public and private property, adjacent buildings, roads, drives, sidewalks, drains, sewers, utilities, trees, structures, and appurtenances from damage due to directional bore work.

The Contractor shall not apply more than the safe pull force to the carrier pipe. This shall be accomplished using an approved breakaway connector between the reamer and the pulling eye.

The Contractor shall install a blue coated tracer wire on all water carrier pipe and green coated tracer wire on all wastewater force main carrier pipe and purple for all reclaimed water carrier pipe.

### 3. EQUIPMENT

The directional drilling equipment shall consist of a directional-drilling rig of sufficient capacity to perform the bore and pull back the pipe. The steerable, directional-boring equipment shall produce a stable fluid-lined tunnel with a minimum burial depth of 54” for the carrier pipe installation.

The tunneling equipment shall employ a fluid cutting technique. The hydraulic power system shall be self-contained and free of leaks, with sufficient pressure and volume to power the drilling operation.

Calibration of the electronic detection system shall be verified by uncovering the tool head at the first ten (10) foot point.

The boring tool head shall be remotely steerable by means of an electronic detection system. The tool head location shall be monitored in three dimensions and logged every 10-feet from the drilling rig. The boring tool shall pull the carrier pipe through the fluid lined tunnel.

The rig shall have means to monitor and record the maximum pullback during the pullback operation. The pulling strength of the boring equipment shall not exceed the piping system safety pull strength as per manufacturer's recommendation.

#### 4. DIRECTIONAL BORE PIPE

##### A. Ductile Iron Pipe:

Ductile Iron Pipe to be directionally bored shall conform to AWWA Specifications C-151. All ductile iron cement lined pipe shall meet the requirements of Pressure Class 350 pipe for sizes 12-inch and smaller, and pressure Class 250 for all pipe 16-inch and larger, unless otherwise indicated by the plans. The exterior of the pipe shall be coated with a bituminous coating of coal-tar or asphalt base at least one mil thick. All pipe shall have a cement lined interior AWWA Specification C-104. Ductile iron pipe shall conform to NSF 372, Reduction of Lead in Drinking Water Act (2014), as applicable. All pipe shall have a minimum bursting tensile strength of 21,000 p.s.i. modulus of rupture. Thickness design is based on Laying Condition "A" or "Type I," unless otherwise noted. The pipe thickness classification shall be Class 50.

Prior to the installation of any pipe on the project, the Contractor shall be required to furnish in writing, proper certification from the manufacturer or a recognized testing agency, that the pipe fulfills every requirement of the specifications set forth above.

Ductile Iron Pipe joints must be mechanical or "field lock" or "gripper" gasket. The manufacture must furnish in writing that the pipe specified for the project by the Contractor is suitable for directional bore applications.

##### B. Polyvinyl Chloride Pipe:

Polyvinyl Chloride Pipe shall be C900/RJ PVC Pipe Manufactured by the CertainTeed Corporation; Eagle Loc 900 PVC Pipe Manufactured by JM Eagle, or approved equal by the Utility Engineer. The pipe is a restrained joint Polyvinyl Chloride Pipe, sizes 4-inch to 12-inch, with cast-iron pipe (CI) outside diameters. Pipe is intended for use in pressure-rated potable water delivery systems, as well as in sewer and fire protection piping systems.

Reference Documents:

ASTM International (ASTM)

ASTM D 1784	Standard Specification for Rigid PVC Compounds and Chlorinated PVC Compounds
ASTM D 2837	Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials
ASTM D 3139	Standard Specifications for Joints for Plastic Pressure Pipes using Flexible Elastomeric Seals
ASTM F 477	Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

American Water Works Association (AWWA)

AWWA C 900	Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4-inch through 60-inch, for Water Distribution
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NSF International

NSF 61	Drinking Water System Components – Health Effects
NSF 372	Reduction of Lead in Drinking Water Act (2014)

Products delivered under this specification shall be manufactured only from water distribution pipe and couplings conforming to AWWA C900. The restrained joint pipe system shall also meet all short and long term pressure test requirements of AWWA C900. Pipe, couplings, and locking splines shall be completely non-metallic to eliminate corrosion problems.

Pipe and couplings shall be made from unplasticized PVC compounds having a minimum cell classification of 12454, as defined in ASTM D1784. The compound shall qualify for a Hydrostatic Design Basis (HDB) of 4000 psi for water at 73.4 degrees F., in accordance with the requirements of ASTM D 2837.

Restrained joint PVC pipe products shall have been tested and approved by Underwriters Laboratories for continuous use at rated pressures. Copies of agency approval reports or products listings shall be provided to the Utility Engineer. Products intended for contact with potable water shall be evaluated, tested, and certified for conformance with NSF 61 by ANSI accredited third-party certifying organization.

Nominal outside diameters and wall thicknesses of restrained joint pipe shall conform to the requirements of AWWA C900. Restrained joint pipe shall be furnished in 4", 6", 10", 12" sizes, in Class 305 (DR14). Pipe shall be furnished in standard lengths of 20-feet.

Pipe shall be joined using non-metallic couplings to form an integral system for maximum reliability and interchangeability. High-strength, flexible thermoplastic splines shall be inserted into mating, precision machined grooves in the pipe and coupling to provide full 360-degree restraint with evenly distributed loading. Couplings shall be designed for use at or above the pressure class of the pipe with which they are utilized, and shall incorporate twin elastomeric sealing gaskets meeting the requirements of ASTM F 477. Joints shall be designed to meet the zero leakage test requirements of ASTM D 3139.

Pipe and couplings shall be homogeneous throughout and free from voids, cracks, inclusions and other defects, and shall be as uniform as commercially practicable in color, density and other physical characteristics.

Every pipe and machined coupling shall pass the AWWA C900 hydrostatic proof test requirements of 2 times the pressure class for 5 seconds. Until such time as UL standards are harmonized with AWWA, UL requirements shall be used, which are 4 times the UL pressure class for 5 seconds.

Pipe and couplings shall be legibly and permanently marked in ink with the following minimum information:

Pipe:

Nominal size (for example, 4")

PVC

Dimension ratio (for example, DR14)

AWWA / UL pressure class (for example, PC 305)

AWWA C900

Manufacturer's name or trademark and production record code

Seal (mark) of the testing agency verifying the suitability of the pipe Material for potable water service

Seal (mark) of the certifying agencies that have tested and approved the pipe for use in fire protection systems

Couplings:

Nominal size (for example, 4")

PVC

AWWA / UL pressure class (for example, PC 305)

AWWA C900

Manufacturer's name or trademark

Seal (mark) of the testing agency verifying the suitability of the pipe material for potable water service

C. HDPE Pipe:

All HDPE pipelines, joints, fittings, shall be in accordance with Section 501 (WATER SYSTEM PIPELINES).

5. DRILLING FLUID ("MUD")

All drilling fluid must be homogenous in nature and must have a pH of 8.5 to 10.0. "Mud" viscosity must meet minimum viscosity as set by the manufacturer for soil conditions expected to be encountered and the contractor shall have appropriate additives for drilling fluid available for different soil conditions (clay, sand, silt, etc.) that may be encountered.

The drilling fluid must not have any additives that are hazardous materials and/or cause taste and odor problems or complaints.

6. TRACER WIRE

All pipelines shall have tracer wire installed in accordance with Section 501 (Water System Pipelines).

7. CONSTRUCTION REQUIREMENTS

All directional bore operations shall be contained within right-of-way and/or easements, or if approved, City of Salina owned property.

Work shall not start until the Contractor has all necessary permits from the appropriate governing regulatory agencies, including the City of Salina.

Contractor shall not begin drilling operation until the inspector is present. The bore shall be scheduled to be completed by 4:00 PM and shall not start after 1:00 PM unless approved by the Utility Engineer.

8. DRILLING REQUIREMENTS

The horizontal alignment shall be as shown on the plans, plus or minus 1 foot. The vertical alignment shall be as shown on the plans, plus or minus 0.5 foot.

The pipe shall have a minimum cover of 54-inches unless specified differently on the plans.

The entry angle shall be 12 degrees to 14 degrees ideally (not to exceed 20 degrees). Exit angle should be 6 degrees to 12 degrees to facilitate the pullback operation and minimize capstan effect tensile stresses on the pipe, unless specified differently on the plan and profile document or in the special provisions.

Drilling mud shall be disposed off-site in accordance with applicable local, state, and federal requirements and/or permit conditions.

All bore pipe to be pulled back on final pass shall have a “breakaway” device installed. The pipe manufacturer will have specifications for the breakaway limit for their difference size pipe.

The Contractor shall not attempt to ream at a rate greater than the drilling equipment and mud system are designed to safely handle. Normal rate of drilling should be between one and two feet per minute.

In the event of a drilling hole blowout, the Contractor shall be responsible for restoring to original condition, any damaged property and cleaning up the environment in the vicinity of the blowout.

## 9. PIPE INSTALLATION

Once pullback operations have commenced, the operation shall continue without interruption until the pipe is completely pulled into the borehole. The frictional resistance is the highest just prior to movement and decreases with movement. The mud starts to gel when it is undisturbed. Therefore, pullback shall never be stopped, except for drilling rod removal, until the pipe is completely pulled into its permanent position.

Adequate lengths of pipe shall be provided at both the launching and the receiving ends to facilitate service connection assemblies.

After pullback, pipe may take several hours to recover from the axial strain. When pulled from the reamed borehole, the pull-nose should be pulled out 3 to 4 percent longer than the total length of the pull to avoid having the pull-nose sucked back below the borehole exit level due to stretch recovery and thermal contraction to an equilibrium temperature.

The pipe entry and exit area shall be graded as needed (by the Contractor) to provide support for the pipe and to allow free movement into the borehole. The pipe shall be guided into the borehole to avoid deformation of, or damage to, the pipe.

If the final grade of the finished bore is not satisfactory to the Utility Engineer, the pipe shall be abandoned, and fully pressure grouted in place, and an alternate installation shall be made. The abandoned pipe shall also be shown on the “as-built” drawings to be submitted.

The Utility Engineer shall inspect the installed pipe for roundness and/or damage. Deformations of more than 10% may be grounds to abandon the bore and the Contractor shall re-drill another line.

## 10. QUALIFICATIONS FOR REJECTION OF DIRECTIONAL BORE

If the installed “Breakaway” devices should fail during pull back.

If the pipe shall fail a hydraulic pressure test as specified by the manufacturer.

If at any time when the pipe is pulled back and any exposed areas have a greater than allowable “gouging” or visible marring of the pipe.

If the vertical and/or horizontal limits are not within tolerances, this may be cause for rejection of the bore.

## 11. POST CONSTRUCTION

The as-built variance from the specified bore path shall not exceed plus or minus 0.5 feet in the vertical plane and plus or minus 1 foot in the horizontal plane.

Pressure testing, leakage testing, preliminary flushing, chlorination and final flushing of mains shall be per SECTION 501 – WATER SYSTEM PIPELINES.

When the directional bore is completed, the Contractor shall provide data log sheets and as-built drawings to the Utility Engineer.