

**APPENDIX A – STANDARD
SPECIFICATIONS – 2019
TRENCHLESS
TECHNOLOGIES**



GARDEN CITY
— KANSAS —

2019



STANDARD SPECIFICATIONS TRENCHLESS TECHNOLOGIES SECTION TT-1

1.1 DESCRIPTION

This section covers construction of trenchless technologies, including fittings, and other appurtenances normally used for trenchless installation of water and sewer piping. This work consists of furnishing and installing pipe, fittings, valves, tracer wire, encasement piping, spacers, testing, cleaning and disinfection of mains and other related work.

1.2 REFERENCES

- A. American National Standards Institute (ANSI), Latest Edition.
- B. American Society of Mechanical Engineers (ASME), Latest Edition.
- C. American Society of Testing Materials (ASTM), Latest Edition.
- D. American Water Works Association (AWWA) Standards, Latest Edition.
- E. Building Officials and Code Administrators (BOCA) International, Inc., Latest Edition.
- F. Factory Mutual (FM), Latest Edition.
- G. International Association of Plumbing and Mechanical Officials (IAPMO), Latest Edition.
- H. Kansas Department of Health and Environment (KDHE), Policies, General Considerations and Design Requirements for Public Water Supply Systems in Kansas, Latest Edition.
- I. Kansas Department of Health and Environment (KDHE), Minimum Standards of Design for Water Pollution Control Facilities, Latest Edition.
- J. UL, LLC, Latest Edition.
- K. Reduction of Lead in Drinking Water Act of 2014 (RLDWA).
- L. NSF International, LLC (NSF), Latest Edition.

1.3 DEFINITIONS

- A. ANSI: American National Standards Institute
- B. ASTM: American Society for Testing and Materials
- C. AWWA: American Water Works Association
- D. CCS: Copper Clad Steel
- E. CI: Cast Iron
- F. CICL: Cast Iron Cement Lined
- G. DI: Ductile Iron
- H. DICL: Ductile Iron Cement Lined
- I. DIPS: Ductile Iron Pipe Size
- J. DR: Dimension Ration
- K. IPS: Iron Pipe Size
- L. MJ: Mechanical Joint
- M. NSF: NSF International

- N. PVC: Polyvinyl Chloride
- O. RJ: Restrained Joint
- P. SJ: Slip Joint
- Q. Trenchless technologies: Methods of installing pipe that do not require extended distances of trench excavation such as directional drilling, auger-jack boring, and other similar applications.

1.4 SUBMITTALS

- A. Product data including the following:
 - 1. Catalog cut and general bulletins.
 - 2. Materials of construction.
 - 3. Manufacturer's certification or affidavit of compliance in accordance with applicable ANSI/AWWA or ASTM standard.
 - 4. Certification of NSF 61 and/or NSF 14.
 - 5. Compliance with RLDWA in accordance with NSF/ANSI 372.
 - 6. Operation, Maintenance, and Installation Manual.
- B. Manufacturer's Instructions: Instructions for installation for all pipe, fittings, and accessories utilized.
- C. Testing Reports as required.

1.5 PROJECT RECORD DOCUMENTS

- A. Submit record documents to the City.
- B. Accurately record exact location of all buried piping and fittings.
- C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store and protect products per manufacturer's recommendations.
- B. Upon delivery, contractor shall inspect pipe and appurtenances for cracking, gouging, chipping, denting, and all other damage and immediately remove from the site. Replacement shall be provided with an acceptable material.
- C. The interior of all products shall be thoroughly cleaned of all foreign matter, and kept clean during construction operations. Protection of interior linings and exterior coatings shall be the contractor's responsibility.

1.7 COORDINATION

- A. Coordinate any connections to the existing system with the City.
- B. Review installation procedures and coordinate the installation of items that must be installed with or before main pipeline construction
- C. Determine if any authorization to use water from the public fire hydrants for construction, testing and flushing is needed. Contractor shall apply for a permit at the appropriate City office to authorize usage of water.
- D. Operation of existing system valves shall be performed by the owner. Contractor may only operate valves if a utility company's representative is on site coordinating the operations.

1.8 MATERIALS

ENCASEMENT PIPE

- a. Steel Sleeve: 4-inch diameter and larger:
 - 1) Materials:
 - a) Use ASTM A252 Grade 3 steel casing pipe, plain end.
 - 2) Minimum wall thickness (inches):

Casing Diameter (inches)	Highway or County	Railroad Crossing	
	Coated or Cathodic Protection	Coated or Cathodic Protection	Uncoated & Unprotected
10 & Under	0.188	0.188	0.188
12 & 14	0.188	0.188	0.250
16	0.219	0.219	0.281
18	0.250	0.250	0.312
20 & 22	0.281	0.281	0.344
24	0.312	0.312	0.375
26	0.344	0.344	0.406
28	0.375	0.375	0.438
30	0.375	0.406	0.469
32	0.406	0.438	0.500
34 & 36	0.469	0.469	0.532

- 3) The exterior of the pipe shall be coated with coal tar epoxy or bituminous asphalt unless noted as uncoated or unprotected on the Drawings.
 - 4) All joints between lengths shall be solidly butt-welded with a smooth non-obstructing joint inside.
 - 5) The casing pipe shall be installed without bends.
- b. The Contractor shall bore and encase pipe as shown on the plans or as directed by the City/Engineer. Borings are to be accomplished with an approved boring rig and with personnel experienced in this type of construction. Boring pits and operations shall be located to avoid conflicts with the public utilities, and other agencies.
 - c. Borings and encasement shall be constructed so they will drain and shall be bored in a single direction. The pipe shall be pulled or pushed into the casing on lubricated skids as shown in the details and approved by the City/Engineer.

DIRECTIONAL DRILLING PIPE

- a. Restrained Joint Polyvinyl Chloride (PVC) Pipe:
 - 1) Conform to AWWA C900 PVC, DR-18, Pressure-Rated Pipe.

- 2) Joints shall be designed to meet the leakage test requirements of ASTM D3139.
- 3) NSF 61 and/or NSF 14 product certified.
- 4) Adhere to the pipe manufacturer's most current calculations regarding tensile load limitations for trenchless application.
- 5) Gaskets meeting ASTM F477.
- 6) Pipe shall be made from resin that will provide mechanical and physical properties that meet or exceed ASTM D1784.
- 7) Model / Manufacturer:
 - a) Restrained Joint PVC as manufactured by CertainTeed Corporation.
 - b) Eagle Loc as manufactured by JM Eagle.
- 8) Contractor shall adhere to the pipe manufacturer's most current calculations regarding tensile load limitations for trenchless application.

Pipe Dia. (in)	Dimension Ratio (DR)	Max. Working Pressure (psi)	Pipe O.D. (in)	Coupling O.D. (in)	Max. Pull-in Force Tightest (Bending) (lbs)	Max. Pull-in Force Straight (No Bending) (lbs)
4	18	150	4.80	5.964	6,700	8,200
6	18	150	6.90	8.366	9,000	12,800
8	18	150	9.05	10.947	18,000	25,200
10	18	150	11.10	13.361	25,600	35,200
12	18	150	13.20	15.836	26,440	41,100

- 9) Adhere to the pipe manufacturer's most current recommendations regarding radius of curvature for pipe used for trenchless application.

Pipe Diameter (in)	Minimum Radius of Curvature (ft)	Change in Pitch per 10 ft. (%)
4	100	10.0
6	150	6.7
8	200	5.0
10	250	4.0
12	300	3.3

- 10) Contractor shall adhere to the pipe manufacturer's most current calculations regarding tensile load limitations for trenchless application.

Pipe Dia. (in)	Dimension Ratio (DR)	Max. Working Pressure (psi)	Pipe O.D. (in)	Max. Pull-in Force Tightest (lbs)
4	18	235	4.80	13,400
6	18	150	6.63	21,900

8	18	150	9.05	37,800
10	18	150	11.10	56,800
11	18	150	13.20	80,300

- 11) Adhere to the pipe manufacturer's most current recommendations regarding radius of curvature for pipe used for trenchless application.

Pipe Diameter (in)	Minimum Radius of Curvature (ft)
4	100
6	144
8	189
10	231
12	275

PIPELINE ACCESSORIES – Subsidiary to Trenchless Technology Construction

- a. Corrosion Protection for Steel Encasement Piping
- 1) Magnesium anodes placed at each end of encasement pipe.
 - 2) Connection of lead wire to encasement pipe shall be by thermite welding.
 - 3) Connection and bare piping shall be coated, wrapped, or both to provide protection equivalent to pipe coating.
 - 4) Magnesium anodes sizing shall be as follows:

$$\text{Encasement Pipe Surface Area (M}^2\text{)} = \frac{(2\pi \times \text{Radius (Inches)} \times \text{Length (Inches)})}{1550}$$

$$\text{Demand (Amps)} = \text{Surface Area (M}^2\text{)} \times \frac{10\text{mA}}{\text{M}^2} (\text{Current Density}) \times 1,000$$

$$\begin{aligned} \text{Protection Capacity (Amp Hours)} \\ = \text{Demand (Amps)} \times 24 \text{ Hrs} \times 365 \text{ Days} \times 20 \text{ Years (Design Life)} \end{aligned}$$

$$\text{Weight of Anode Required (lb)} = \frac{\text{Protection Capacity (Amp Hours)}}{500 \frac{\text{Ah}}{\text{lb}} \text{ Anode}}$$

$$\text{Weight of Anode on each end of casing (lb)} = \frac{\text{Weight of anode required (lb)}}{2}$$

- b. Tracer Wire
- 1) Utilize on all directional drilled/auger & jack bored non-ferrous pressure pipelines.
 - 2) Material: Blue No. 10 CCS wire, minimum; coated (minimum of 45 mils thick), plastic insulated as manufactured by Copperhead or

- approved equal. The insulation shall be heat, oil, and gasoline resistant.
- 3) Shall run along the centerline of the pipe and taped to the pipe.
- 4) Electrical tape shall cover splice locations so that no bare wire is exposed.
- 5) Splices in the tracer wire shall be connected with snake bite locking wire connectors as manufactured by Copperhead or approved equal.
- 6) Tracer wire shall have a minimum break load of at least 2,000 lb.
- c. Tracer Wire Test Station
 - 1) Shall be installed adjacent to all fire hydrants, lift stations, outlet structures, pig launching/receiving stations, manholes along the waterline/forcemain and at blow-off assemblies or valves near the ends of the waterlines/forcemains. Any exceptions to locations of test stations shall be approved by the City/Engineer.
 - 2) At each test station, the tracer wire shall be connected to a one pound zinc or magnesium anode. Anodes shall also be attached to the tracer wire at both the beginning and end of the proposed waterline/forcemain. Anodes shall be buried at the same elevation as the pipeline at each location. The anodes shall be connected to the CCS wire which shall be extended to the test station.
 - 3) Test station shall be galvanized or polypropylene material "condulet" style with removable solid cover having two leads extending from the face.
 - 4) The test shall be attached to a 1-inch conduit (36" length minimum).
 - 5) In concrete environments, such as sidewalks in downtown areas, the contractor shall use the flush style test station.
 - 6) Manufacturer: AGRA Industries, Farwest Corrosion Control Company, or approved equal.
 - 7) Model / Manufacturer:
 - a) Copperhead Industries, LLC; Monticello, MN.
 - b) Farwest Corrosion Control Company; Downey, CA.
 - c) Substitutions: Under provisions of Section 01600.

1.9 PREPARATION

- a. Provide equipment to guard against electrocution and an alarm system on boring and drilling equipment capable of detecting electrical current as it approaches electric lines.
- b. Excavate pits per working plan approved by City.
- c. Test pit underground utility crossings before boring or horizontal directional drilling operation.

1.10 OPERATION

- a. Determine bore and drilling length and equipment pull strength for type of soil encountered.

- b. Contractor shall provide all material, equipment, and facilities required for boring and directional drilling.
- c. Provide method to control line and grade.
- d. Provide and maintain instrumentation that accurately locates pilot hole.
- e. Drill pilot hole along path following Drawings to these tolerances:
 - 1) Vertical alignment plus or minus 0.5 foot. Vertical path of the pilot hole must not establish new high points not shown on the drawings.
 - 2) Horizontal alignment plus or minus 1.0 foot.
- f. Include electronic monitoring of the horizontal and vertical boring or drilling head location. Obtain an accuracy range within 1 inch of actual position of the pipeline. Record position readings at a maximum of 25 foot intervals.
- g. At completion of pilot hole drilling, furnish City/Engineer tabulations of horizontal and vertical alignment.
- h. Dewatering: Provide and maintain a dewatering system of sufficient capacity to remove water when encountered.
- i. Maintain close observation to detect if settlement or displacement of surface and any adjacent facilities. Notify City/Engineer immediately if settlement or displacement is detected.
- j. Boring and Drilling Operations:
 - 1) Maintain drilling fluid in bore hole to increase stability of the surrounding soil (horizontal directional drilling only).
 - 2) Dispose of drilling fluid and other spoils at a location following laws, ordinances, rules and regulations.
 - 3) Provide clean water for drilling, at no cost to the Owner.
 - 4) Exercise caution including, but not limited to locating utilities, drilling test pits to observe drill stems or reamer assembly to clear other existing utilities at necessary locations.

1.11 INSTALLATION

- a. Provide a swivel to reaming assembly and pull section of pipe to minimize torsional stress on pull section after drilling pilot hole.
- b. Hold reaming diameter to 1.5 inches or less of the outside diameter of the pipe being installed.
- c. Pull detection wire along with pipe installation.
- d. City/Engineer may order test pits to verify horizontal and vertical alignment if the installation is not in compliance with the contract documents.
- e. Contractor will replace portions of the pipeline not in compliance with the Contract Documents at City/Engineer's direction and at no additional cost to the owner.
- f. The use of water under pressure or puddling will not be permitted to facilitate boring, pushing, or jacking operations under KDOT right of ways.
- g. Encasement piping under KDOT right of ways shall be installed by either dry auger boring (auger and jacking), dry directional bore (directional

drilling with minimal fluid use), or another KDOT approved boring method as allowed by the KDOT Utility Accommodation Policy and approved by the district engineer.

1.12 CERTIFICATION BY MANUFACTURER

- a. When required by the City/Engineer, the Contractor shall furnish certification by the manufacturer of the pipe, fittings, valves, hydrants, and other appurtenances to be furnished on this project, certifying that the materials comply with the applicable specifications.
- b. All pipe shall be clearly marked with type, class and/or thickness as applicable. Lettering shall be legible and permanent under normal conditions of handling and storage.

1.13 MEASUREMENT AND PAYMENT

A. GENERAL

1. Payment for work performed by the Contractor under this section of the Specifications will be made at the approved contract unit price for each of the items listed in the bid and measured as hereinafter specified. Such payment shall compensate the Contractor for all costs in connection with furnishing all labor, equipment and material required and performing the operations necessary to complete the items in accordance with the Contract Documents. All incidental work essential to completion of the project in a skillful manner, including cleanup and disposal of waste or surplus material, shall be accomplished by the Contractor at no additional cost to the Owner. Quantities listed in the bid are not guaranteed and are indicated only for convenience in comparing bids. Payment will be made for actual quantities constructed or installed as authorized by these Contract Documents; be they more or less than those listed; said quantities being measured and determined as follows.
2. Schedule all construction operations in order to ensure that the water supply, water treatment, and water distribution facilities are operating to maintain the required level of supply, treatment and distribution until final switch over to newly installed equipment is completed.
3. The existing water treatment processes shall remain in operation until new water system is completed, tested and approved by City/Engineer.
4. Any shutdown of operations to permit new construction or revisions shall be coordinated with and under the control of the Owner's operations personnel and City/Engineer.
5. Throughout project construction, coordinate the construction sequence with the City/Engineer. Coordinate any diversions from construction sequence.
6. Other construction sequence constraints may be necessary to follow the Kansas Department of Health and Environment (KDHE) requirements.
7. A minimum of 48 hours prior to making connections to existing systems which will interrupt services to the utility users, the Contractor shall notify the Owner's personnel and affected customers, stating the approximate time and duration of

interruption of service and shall limit such interruption to a duration mutually agreeable to all parties.

8. Bypassing of untreated raw water through the proposed or existing system to the distribution system at any time shall not be allowed unless coordinated with City/Engineer.
9. Final grading, graveling, seeding, fencing, etc. shall be accomplished in a timely fashion.
10. Any construction around or through private access driveways shall be coordinated with homeowner/business, City/Engineer 48 hours prior to construction. Contractor must provide a means of access at all times.
11. No water utility user shall be without service for more than four (4) hours.
12. Testing and disinfection of all waterlines and equipment must be completed prior to initiating them into service.

B. WATERLINE BY DIRECTIONAL DRILL

1. will be paid for at the contract unit price per linear foot installed and measured on the centerline of the pipeline installed (horizontal to existing grade—no additional length will be paid for required curvature of pipe) for the respective pipe size indicated on the Drawings. This item shall include all costs in connection with furnishing and installing all pipe, fittings, caps or plugs, reducers, clamps, sleeves, couplings, joint materials; restrained joints and special use fittings; seals; tracer wire; tracer wire access boxes; excavation and over excavation of bore pits; stockpiling of topsoil; pit stabilization; dewatering as necessary; standard excavation; tunneling under or removing and replacing surface obstructions; discovery and protection of subsurface obstructions; electronic monitoring; connecting to existing systems; mechanical restraints; backfilling and compaction; coordinating with Owner on salvage or disposal of surplus and waste materials; flushing, disinfecting of the potable water mains; testing; grading; notification and coordination with adjacent landowners; borrow and disposal of soil as necessary; and all other incidental and appurtenant work required to complete this item.

C. STEEL ENCASEMENT BY DIRECTIONAL DRILL

1. will be paid for at the contract unit price per linear foot, measured on the centerline of the encasement installed. This item shall include all costs in connection with discovery and protection of subsurface obstruction; bore pit excavation; removing and replacing surface obstructions; furnishing and installing steel encasement pipe; furnishing and installing all carrier pipe, pipe spacers, and encasement end seals; furnishing and installing cathodic protection (as required); coordinating and providing any necessary traffic control; and all other incidental and appurtenant work required to complete this item.

D. STEEL ENCASEMENT BY AUGER AND JACK BORING

1. will be paid for at the contract unit price per linear foot, measured on the centerline of the encasement installed. This item shall include all costs in connection with discovery and protection of subsurface obstruction; pit

excavation and compaction; dewatering as necessary; stockpiling of topsoil; removing and replacing surface obstructions; auger and jack of encasement; furnishing and installing encasement pipe; furnishing and installing carrier pipe; connection to new/existing piping; tracer wire; tracer wire access boxes; furnishing and installing all pipe spacers and encasement end seals; furnishing and installing cathodic protection; pipe location signs (where necessary); removal and replacement of surfacing (any type); removal and replacement of existing irrigation systems; testing; and all other incidental and appurtenant work required to complete this item.

E. FORCEMAIN PIPING – DIRECTIONAL DRILL

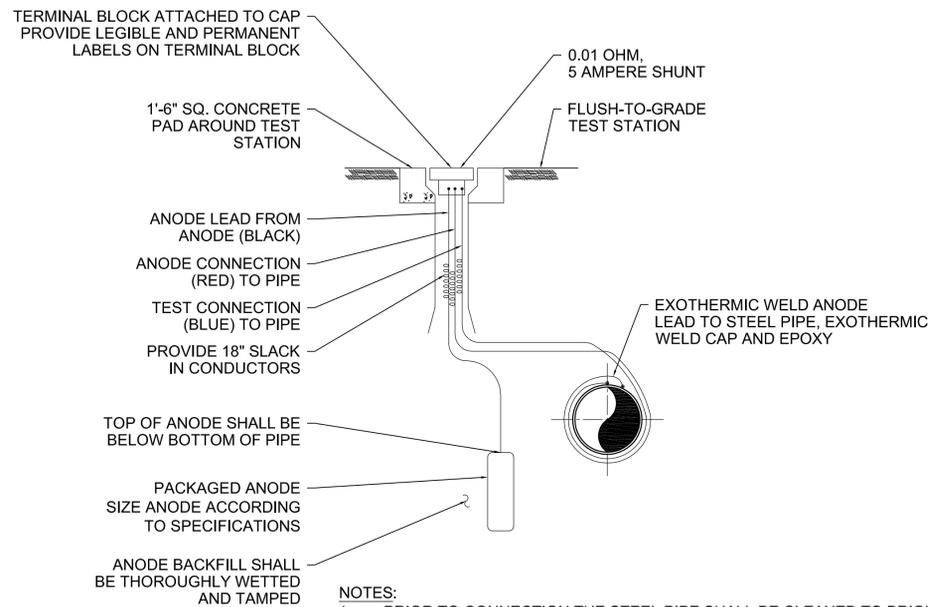
1. Directional drill of forcemain piping will be paid for at the contract unit price per linear foot, measured along the centerline of the force main installed (horizontal to existing grade – no additional length will be paid for required curvature of pipe). This item shall include all costs in connection with discovery and protection of subsurface obstructions; dewatering as necessary; bore pit excavation and over excavation; shoring and bracing as required; removing and replacing surface obstructions; furnishing and properly installing pipe, tracer wire, and appurtenances; seals; electronic monitoring; disposal of surplus waste materials; backfilling and compaction; compaction testing; providing fill dirt as necessary; pressure testing; grading; removal and replacement of surfacing as necessary; notification and coordination with landowner; coordination with steel encasement installation; and all other incidental and appurtenant work required to complete this item.

F. GRAVITY SEWER MAIN – AUGER & JACK BORING

1. Auger & jack boring of gravity sewer main will be paid for at the contract unit price per linear foot, measured on the centerline of the encasement installed (horizontal to existing grade – no additional length will be paid for required curvature of pipe). This item shall include all costs in connection with furnishing and installing all pipe; special use fittings; couplings; joint materials; restrained joints;

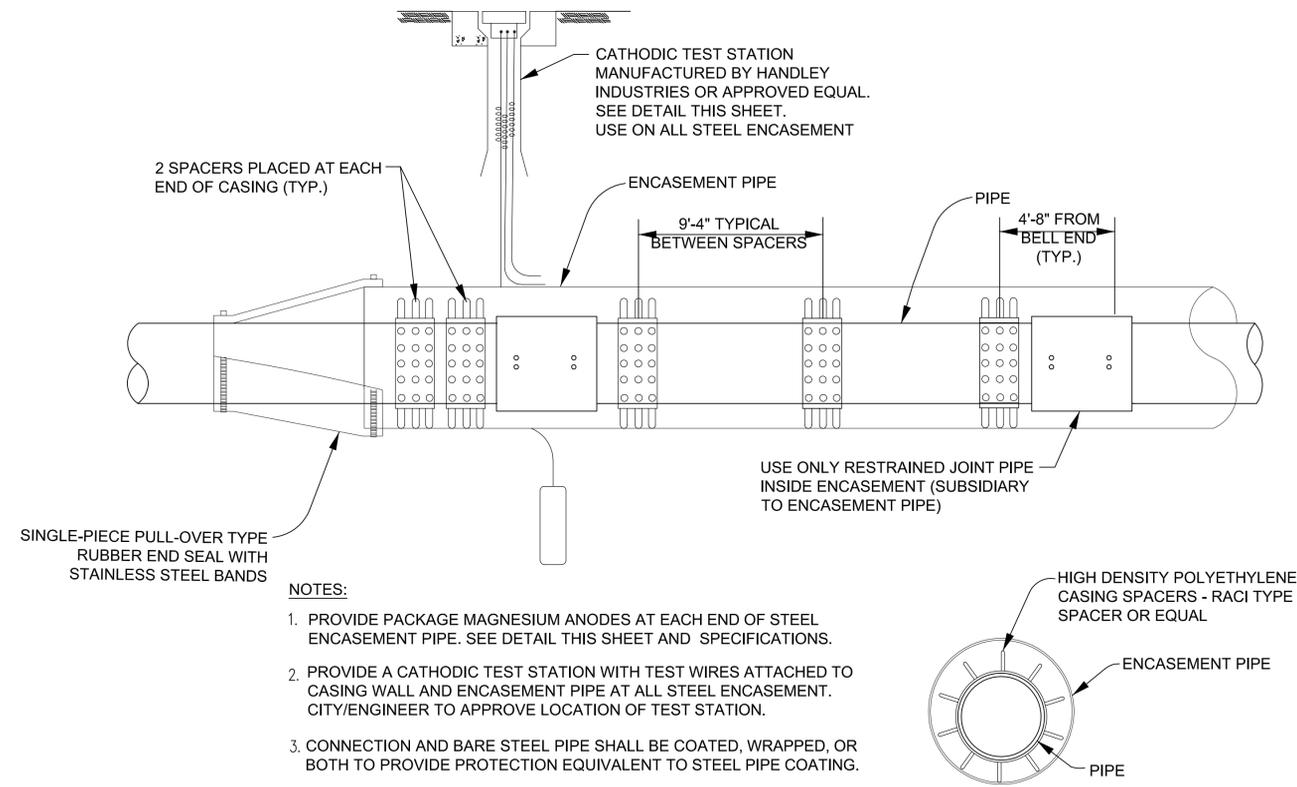
1.14 ACCEPTANCE OF WORK

- A. For all projects involving the City's water and wastewater facilities, work shall not be formally accepted by the City until the Contractor provides the City with two (2) copies of as-built drawings in accordance with Section 10 (k) of the City's General Conditions. Actual field dimensions between fittings, valves, hydrants, and other appurtenances shall be documented on these drawings, to the satisfaction of the City of Garden City Water/Wastewater Department. In addition, dimensional ties will also be noted to physical aboveground features, which will locate the buried work.



- NOTES:**
1. PRIOR TO CONNECTION THE STEEL PIPE SHALL BE CLEANED TO BRIGHT METAL, FREE OF ALL OIL, MILL SCALE, CORROSION PRODUCTS, OR OTHER FOREIGN MATTER.
 2. TEST WELD WITH HAMMER.
 3. PROVIDE DURABLE, WEATHERPROOF SIGNS LOCATED AT CENTERLINE OF PIPE @ ROW ON BOTH SIDES OF TRACKS. SIGNS TO INCLUDE: NAME/ADDRESS OF OWNER, CONTENTS OF PIPE, PRESSURE OF PIPE, PIPE DEPTH @ SIGN, AND EMERGENCY PHONE NUMBER.

CATHODIC PROTECTION ANODE AND TEST STATION DETAIL



- NOTES:**
1. PROVIDE PACKAGE MAGNESIUM ANODES AT EACH END OF STEEL ENCASEMENT PIPE. SEE DETAIL THIS SHEET AND SPECIFICATIONS.
 2. PROVIDE A CATHODIC TEST STATION WITH TEST WIRES ATTACHED TO CASING WALL AND ENCASEMENT PIPE AT ALL STEEL ENCASEMENT. CITY/ENGINEER TO APPROVE LOCATION OF TEST STATION.
 3. CONNECTION AND BARE STEEL PIPE SHALL BE COATED, WRAPPED, OR BOTH TO PROVIDE PROTECTION EQUIVALENT TO STEEL PIPE COATING.

PIPE ENCASEMENT DETAIL



City of Garden City, Kansas		
Public Utilities Department	Water Division	Engineering Department
Wastewater Treatment Plant	Water Service Center	City Administrative Center
345 S. Jennie Barker Rd., Garden City KS 67846	106 S. 11th St., Garden City KS 67846	301 N. 8th St., Garden City KS 67846
Standard Details ~ Trenchless Technology		
City Engineer: Wilson & Company	Revisions	Dr. By: JTA
Date: 10/02/2019		Ck. By: DAG
Scale: NONE		Dr. No.: 1 of 1