SECTION 02250
TRENCHLESS INSTALLATION

PART 1 GENERAL
1.01 – Section Includes
A. Trenchless installation of casing pipe.
B. Trenchless installation of carrier pipe.
C. Open cut installation of casing pipe.

1.02 – Description of Work
A. Trenchless Installation of Casing Pipe: Work includes the excavation of boring and receiving pits, any required sheeting, shoring, and bracing, dewatering, and the trenchless installation of a casing pipe.
B. Trenchless Installation of Carrier Pipe: Work includes the excavation of boring and receiving pits, any required sheeting, shoring, and bracing, dewatering, and the trenchless installation of a carrier pipe.
C. Open Cut Installation of Casing Pipe: Work includes any required sheeting, shoring, and bracing, dewatering, and the excavation and trench installation of a casing pipe by open cut methods.

1.03 – Submittals
A. Submit plan for trenchless operation to the Engineer, including backfill methods within the casing pipe, if required, subject to requirements of paragraph 2.01.
B. Submit dewatering plan to the Engineer.
C. Submit certificate of compliance indicating materials incorporated into the Work comply with the Contract Documents.
D. Submit Shop Drawings on carrier pipe support systems.
E. Submit pipe and casing manufacturer’s recommendation for casing spacer placement.

1.04 – Delivery, Storage, and Handling
Store excavated material in locations which minimize interference with operations, minimize environmental damage, and protect adjacent areas from flooding, runoff, and sediment disposition.

1.05 – Scheduling and Conflicts
A. Schedule Work to minimize disruption of public streets and facilities.
B. Conform to Staging Plan in Contract Documents.

1.06 – Special Requirements
A. Notify the Engineer immediately if contaminated soils, historical artifacts, or other similar such conditions are encountered.
B. All Work and materials incorporated into this Project shall conform to all applicable local, state, and federal requirements.

PART 2 PRODUCTS
2.01 – Casing Pipe
A. The casing type and characteristics shall be the following unless otherwise noted in the Contract Documents:
   1. Casing pipe: Welded steel pipe ASTM A-139, Grade B, with minimum 35,000 psi (241,325 kPa) yield strength.
   2. The encasing pipe shall be clean and coated, on the outside, with two coats of coal tar paint, Kopper “Bitumastic Super Service Black,” Mobile “High-Build Bituminous
Coating 35-J-10, "Tnemec "46-465 HB Tnemecol," or equivalent. 4-mL coat thickness.

3. Unless noted otherwise on the Plans, steel casing pipe shall have a minimum nominal diameter
   a. For carrier pipe sizes 12 inches and larger: Minimum 4 inches larger than bell OD of the carrier pipe.
   b. For carrier pipe sizes less than 12 inches: Twice the carrier pipe nominal diameter.
   c. Wall thicknesses shall conform to the following table:

<table>
<thead>
<tr>
<th>Casing Diameter (inches)</th>
<th>Minimum Casing Pipe Wall Thickness (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Under Roadways</td>
</tr>
<tr>
<td>8 – 12</td>
<td>0.188</td>
</tr>
<tr>
<td>14 – 16</td>
<td>0.188</td>
</tr>
<tr>
<td>18</td>
<td>0.250</td>
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<tr>
<td>20 – 22</td>
<td>0.250</td>
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<tr>
<td>24 – 26</td>
<td>0.281</td>
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<tr>
<td>28 – 30</td>
<td>0.3125</td>
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<tr>
<td>32 – 34</td>
<td>0.3125</td>
</tr>
<tr>
<td>36 – 48</td>
<td>0.344</td>
</tr>
</tbody>
</table>

   d. Larger casing pipe may be substituted at no additional cost to the Owner.

B. Joints
      a. Welders must be qualified according to Iowa D.O.T. Materials IM 560.
      b. Welds must comply with Iowa D.O.T. Materials IM 558.
   2. Upon Engineer’s approval, an interlocking casing pipe connection system may be used in lieu of field welding casing pipe sections.

C. If casing pipe installation is under a railroad, the casing shall be smooth steel pipe conforming with American Railway Engineering Association (AREA) and/or the railroad company’s standards for jacked installations. The casing shall have a coal tar pitch varnish finish inside and out.

2.02 – Carrier Pipe
   The carrier pipe shall be as set forth in the Contract Documents.

2.03 – Casing Spacers
   A. Use of wooden shims to support carrier pipe not permitted.
   B. Pipes up to 6-inch diameter:
      1. Band: HDPE or PVC; ASTM D638
      2. Risers: HDPE or PVC, integrally molded to band; ASTM D638
      3. Runners
         a. Low-friction abrasion resistant polyethylene
         b. Mechanically secured to riser with stainless steel fasteners
   C. Pipes greater than 6-inch diameter:
      1. Band: HDPE, PVC or Type 304 stainless steel with PVC liner
      2. Risers: Type 304 stainless steel per ASTM A240
         a. Mechanically secured (stainless steel fasteners) or welded to band
         b. Reinforced
c. Adjustable to allow carrier pipe to be placed at design grade within casing

3. Runners
   a. Low-friction abrasion resistant polyethylene
   b. Mechanically secured to riser with stainless steel fasteners

D. Approved Manufacturers: Cascade Water Works Manufacturing Company or approved equal.

2.04 – Vents and Cathodic Protection

Vents and Cathodic protection shall be as set forth in the Contract documents.

2.05 – End Seals

A. Single Pipe Installations
   1. Watertight mechanical rubber end seals
      a. Neoprene, minimum 1/8-inch thickness
      b. Pull-over type, wrapping around ends on casing pipe and barrel of carrier pipe
      c. Secure to casing pipe and carrier pipe with Type 304 stainless steel bands
   2. Model CCES as manufactured by Cascade Water Works Manufacturing Company, or approved equal.

B. End seals for multiple pipe installations shall be hand-formed from concrete brick and mortar.

2.06 – Backfill

A. Abandoned Tunnels or Casings
   1. Iowa D.O.T. Class C concrete, approximately 4-inch slump
   2. Flowable mortar or controlled low strength material (CLSM)

B. Casing
   1. PCC: Iowa D.O.T. Class C concrete, approximately 4-inch slump
   2. Flowable mortar
   3. Controlled low strength material (CLSM)

C. Backfill Launching and Receiving Pits with suitable excavated materials

PART 3 EXECUTION

3.01 – Excavation

A. Excavate launching and receiving pits at the approved locations. Provide sheeting, shoring, or bracing required to provide for safe working conditions.
   1. Remove topsoil to minimum 12-inch depth and stockpile.
   2. Protect existing facilities, trees, and shrubs.
   3. Place excavated material away from trench.
   4. Grade and shape spoil piles to drain and to protect adjacent areas from runoff. Do not allow spoil piles to obstruct drainage. Stabilize stockpiles with seeding and provide sediment control around stockpiles.
   5. Remove rock, rubbish, debris, and other material not suitable for backfill.

B. After the excavation is opened, the pipe installation shall follow immediately to avoid unnecessarily disturbing the stability of the embankment and roadbed.
C. Dewater the excavation in a manner appropriate for the conditions and in accordance with Section 02200.

3.02 – Trenchless Installation Methods and Requirements

A. General
1. If applicable, use one of the methods specified or recommended in Contract documents.
2. If no method is specified, select installation methods appropriate for anticipated soil conditions and meet the following:
   a. Allows pipe to be installed to desired line and grade within specified tolerances.
   b. Prevents heaving or settlement of ground surface or damage to nearby facilities.
   c. Prevents damage to carrier pipe and any lining materials within carrier pipe.

B. Installation Methods:
1. Auger Boring and/or Steered Auger Boring: A method utilizing a rotating cutting head to form the bore hole and a series of rotating augers inside a casing pipe to remove spoil. Steered auger boring utilizing electronic controls to maintain line and grade.
2. Directional Drilling: A method for installing pipe from a surface-launched drilling rig. A pilot bore is formed and then enlarged by back reaming and removing the spoil material. The pipe is then pulled into place.
3. Open-ended Pipe Ramming: A method involving driving a steel casing pipe with a percussive hammer. The front end of the casing pipe is open-ended. Spoils are removed from the pipe.
4. Pipe Jacking: A method in which pipe is pushed into the ground with hydraulic jacks while soil is simultaneously excavated. Excavation is normally completed with a tunnel boring machine.
6. Utility Tunneling: A method of forming large diameter tunnels. As excavation takes place at the front of the tunnel, a liner is constructed to temporarily support the tunnel. Upon completion of the tunnel, the pipe is pushed into place.
7. Other: Other methods may be allowed with the Engineer’s approval.

C. Comparison of Different Trenchless Methods
2. Abbreviations
   a. PE = Polyethylene
   b. PVC = Polyvinyl Chloride
   c. RCP = Reinforced Concrete Pipe
   d. DIP = Ductile Iron Pipe
   e. VCP or ESVCP = Vitrified Clay Pipe or Extra Strength Vitrified Clay Pipe
   f. HDD = Horizontal Directional Drilling
   g. AB = Auger Boring
3. Table

<table>
<thead>
<tr>
<th>Method</th>
<th>Pipe Dia. Range (Inches)</th>
<th>Maximum Installed Length (Feet)</th>
<th>Pipe Material</th>
<th>Typical Accuracy*</th>
</tr>
</thead>
<tbody>
<tr>
<td>AB</td>
<td>4-60</td>
<td>600</td>
<td>Steel</td>
<td>± 1% length of bore</td>
</tr>
<tr>
<td>AB-Steer on Grade</td>
<td>4-60</td>
<td>600</td>
<td>Steel</td>
<td>± 12 inches</td>
</tr>
<tr>
<td>AB-Steer on Line and Grade</td>
<td>4-60</td>
<td>600</td>
<td>Steel</td>
<td>± 12 inches</td>
</tr>
<tr>
<td>Pipe Ramming</td>
<td>2-55</td>
<td>200</td>
<td>Steel</td>
<td>Not accurate</td>
</tr>
<tr>
<td>Micro – HDD</td>
<td>Up to 4</td>
<td>Up to 150</td>
<td>PE, Steel, PVC</td>
<td>Varies</td>
</tr>
<tr>
<td>Mini – HDD</td>
<td>4-12</td>
<td>Up to 600</td>
<td>PE, Steel, PVC</td>
<td>Varies</td>
</tr>
<tr>
<td>Midi – HDD</td>
<td>12-24</td>
<td>600 – 2000</td>
<td>PE, Steel</td>
<td>Varies</td>
</tr>
<tr>
<td>Maxi – HDD</td>
<td>Up to 60</td>
<td>More than 2000</td>
<td>PE, Steel</td>
<td>Varies</td>
</tr>
<tr>
<td>Micro Tunneling</td>
<td>8 and Up</td>
<td>750</td>
<td>RCP, VCP, ESVCP, DIP, Steel, PVC</td>
<td>Varies</td>
</tr>
<tr>
<td>Pipe Jacking</td>
<td>42 and Up</td>
<td>1600</td>
<td>RCP, Steel</td>
<td></td>
</tr>
<tr>
<td>Utility Tunneling</td>
<td>42 and Up</td>
<td>1600</td>
<td>RCP, Steel</td>
<td></td>
</tr>
</tbody>
</table>

*Accuracy is Dependent on Operation Skill, Contractor Experience and Site Conditions

D. Line and Grade:

1. Install pipe at line and grade that will allow the carrier pipe to be installed at its true starting elevation and grade within the specified maximum alignment deviation of the pipe centerline.

2. When no deviation tolerances are specified in the contract documents, apply the following maximum deviations to the carrier pipe:
   a. Gravity Pipe:
      1) Horizontally: ± 1.0 foot per 100 feet
      2) Vertically: ± 0.2 feet up to 100 feet; an additional ± 0.1 foot per 100 feet thereafter. Maintain the minimum depth specified in the contract documents. **Backfall in pipe not allowed.**
   b. Pressurized Pipe:
      1) Horizontally: ± 2.0 feet
      2) Vertically: ± 1.0 foot. Maintain the minimum depth specified in the contract documents.

3. Greater deviation, interference with other identified facilities, or final alignment and grade that excessively compromise design functionality may be cause for rejection.

E. Deviation from Line and Grade:

1. Provided adequate clearance remains for proper installation of the carrier pipe, the Contractor will be allowed to correct deviations in grade of a casing pipe in order to achieve design grade of the carrier pipe by:
   - Pouring an invert in the casing pipe, or
   - Shimming the carrier pipe with casing spacers to a uniform grade.

2. Installations deviating from the specified tolerances that cannot be adjusted to conform to the specified tolerances may be rejected by the Engineer. If non-conforming installation is not rejected, provide all additional fittings, manholes, or appurtenances needed to accommodate horizontal or vertical misalignment, at no
additional cost to the Jurisdiction.

3. Abandon rejected installation plus fill and seal ends with special fill materials, at no additional cost to the Jurisdiction. Replace abandoned installations, including all additional fittings, manholes, or appurtenances required.

3.03 – Installation of Casing Pipe

A. Install casing pipe by approved and suitable methods.

B. The leading section of the pipe should be equipped with a jacking head securely anchored thereto to prevent any wobble or variation in alignment during the boring and jacking operation.

C. The driving end of the pipe shall be properly protected against damage. Intermediate joints shall be similarly protected by the use of sufficient bearing shims to properly distribute the jacking stresses. Any section of casing pipe showing signs of damage shall be removed and replaced, or repaired to the satisfaction of the Engineer. Do not exceed compression or tensile strength of casing pipe during pushing or pulling operations.

D. Excavation shall not be made in excess of the outer dimensions of the pipe being jacked unless approved by the Engineer. Every effort shall be made to avoid loss of earth outside the jacking head. Excavated material shall be removed from the conduit as excavation progresses, with no accumulation of such material within the conduit.

E. Once casing pipe installation has commenced, it shall be continued uninterrupted around the clock until the casing pipe has been jacked between the specified limits. This requirement may be modified if the Contractor submits to the Engineer for prior approval, methods and details that prevent freezing of the casing pipe and ensure the head is stable at all times.

F. If appreciable loss of soil occurs during installation, the voids shall be backpacked promptly to the extent practicable with soil-cement consisting of a slightly moistened mixture of 1 part cement to 2 parts sand mortar. This mixture shall be thoroughly mixed and rammed into place as soon as possible after soil loss occurs.

G. If casing pipe installation cannot progress as a result of encountering obstructions (such as rock), the Contractor shall be responsible to contact the Engineer for approval to remove the obstruction or relocate the installation. If the Engineer orders relocation, backfill the abandoned casing pipe with flowable mortar and cap the end. The Engineer shall measure the length of abandoned casing pipe for the purpose of payment for Work completed.

H. The Contractor is responsible to safely mark and protect the excavation until the operation is complete and the excavation is backfilled.

I. The excavation shall be backfilled in accordance with Section 02200 following extension of the carrier pipe beyond the backfilling operation.

3.04 – Carrier Pipe Installation through Casing

A. Clean dirt and debris from the interior of the casing pipe after installation.

B. Install casing spacers on carrier pipe sections as necessary to support the pipe barrel according to the pipe manufacturer’s and casing spacer manufacturer’s recommendations subject to the following minimum requirements:
   1. Install a spacer within 1 foot on both sides of carrier pipe joints and at a maximum spacing of 6 feet.
   2. Do not allow the pipe to be supported by pipe bells.
   3. Lubricate casing spacer runners with drilling mud or flax soap. Do not use petroleum-based lubricants or oils.

C. Ensure thrust loads will not damage carrier pipe joints. Provide thrust collars between joint shoulders of concrete pipe.

D. Provide timbers for sufficient cushioning between the end of the pipe pushed and the jacking equipment to prevent damage to the pipe. Do not allow the steel jack face to thrust
against the unprotected pipe end.
E. Position jacks so the resulting force is applied evenly to the entire end of the pipe.
F. Assemble pipe joints in the jacking pit before pushing the carrier pipe into the casing.
G. Close the end of the casing pipe around the carrier pipe with a casing end seal.
H. When specified in the Contract documents, fill the annular space between the carrier and casing pipe with flowable mortar or CLSM.

3.05 – Installation of Carrier Pipe without Casing
A. Upon completion of the trenchless operation, fill all voids around the outside face of the carrier pipe by grouting.
B. Water main shall not be installed by directional drilling or horizontal boring without a casing pipe, unless specified otherwise in the Contract documents.

3.06 – Open Cut Installation of Casing Pipe
A. Complete trench excavation for a casing pipe in accordance with Section 02200, including any required sheeting, shoring, and bracing and/or dewatering.
B. Weld stabilizing joints with a continuous circumferential weld.
C. Following the completion of the casing installation, install the carrier pipe according to Section 02250 and seal casing ends in accordance with the Contract documents.
D. Backfill excavation in accordance with Section 02200 following extension of the conduit beyond the backfilling operation.
E. The Contractor is responsible to safely mark and protect the excavation until the operation is complete and the excavation is backfilled.

3.07 – Special Requirements for Railroad Operations
A. Provide minimum of 72 hours notice to the area Roadmaster of the railroad company prior to commencing Work, including trenchless operations, within or immediately adjacent to railroad right-of-way.
B. During all Work within railroad right-of-way, including trenchless operations, arrange with the railroad company for the provision of railroad flaggers and on-track safety training.

3.08 – Pit Restoration
A. Remove installation equipment and unused materials from the launching and receiving pits.
B. When the carrier pipe extends beyond the limits of trenchless installation and into the bore pit, place bedding and backfill material according to Section 02200.
C. Place suitable backfill material in the pit. Apply the testing requirements of Section 02200.
D. Restore the site to original condition or better.

END OF SECTION 02250