

**TRENCHLESS CONSTRUCTION (BORING, JACKING, AND TUNNELING)****PART 1 - GENERAL****1.01 SECTION INCLUDES**

- A. Trenchless Installation of Carrier Pipe with Casing Pipe
- B. Trenchless Installation of Carrier Pipe without Casing Pipe

**1.02 DESCRIPTION OF WORK**

- A. Excavate launching and receiving pits.
- B. Install casing or carrier pipe by trenchless methods.
- C. Install carrier pipe inside casing pipe (if required).
- D. Place backfill material in excavations.

**1.03 SUBMITTALS**

Comply with Division 1 - General Provisions and Covenants, as well as the following:

- A. Proposed installation methods and equipment.
- B. Gradation reports for bedding materials if required.
- C. Shop drawings of casing spacers and proposed spacing.
- D. Dewatering plan (if required).

**1.04 SUBSTITUTIONS**

Comply with Division 1 - General Provisions and Covenants.

**1.05 DELIVERY, STORAGE, AND HANDLING**

Comply with Division 1 - General Provisions and Covenants.

**1.06 SCHEDULING AND CONFLICTS**

Comply with Division 1 - General Provisions and Covenants.

**1.07 SPECIAL REQUIREMENTS**

None.

**1.08 MEASUREMENT AND PAYMENT**

All items of work contained in this section are incidental to the underground utility pipe being installed and will not be paid for separately.

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**PART 2 - PRODUCTS****2.01 CARRIER PIPE****A. Carrier Pipe Installed within Casing Pipe:**

1. **Sanitary Sewer Gravity Main:** Comply with Section 4010, 2.01.
2. **Sanitary Sewer Force Main:**
  - a. **Restrained Joint Ductile Iron Pipe:** Comply with Section 4010, 2.02.
  - b. **Restrained Joint PVC Pipe:** Comply with Section 4010, 2.02.
3. **Storm Sewer:** Comply with Section 4020, 2.01.
4. **Culverts:** Comply with Section 4030, 2.01.
5. **Water Main:**
  - a. **Restrained Joint Ductile Iron Pipe:** Comply with Section 5010, 2.01.
  - b. **Restrained Joint PVC Pipe:** Comply with Section 5010, 2.01.

**B. Carrier Pipe Installed without a Casing Pipe:**

1. **Sanitary Sewer Gravity Main:**
  - a. **Reinforced Concrete Pipe:** Comply with Section 4010, 2.01.
  - b. **Vitrified Clay Pipe:** Comply with Section 4010, 2.01.
  - c. **Restrained Joint Ductile Iron Pipe:** Comply with Section 4010, 2.02.
  - d. **Restrained Joint PVC Pipe:** Comply with Section 4010, 2.02.
2. **Sanitary Sewer Force Main:**
  - a. **Restrained Joint Ductile Iron Pipe:** Comply with Section 4010, 2.02.
  - b. **Restrained Joint PVC Pipe:** Comply with Section 4010, 2.02.
3. **Storm Sewer and Culverts:**
  - a. **Reinforced Concrete Pipe:** Comply with Section 4020, 2.01.
  - b. **Reinforced Concrete Arch Pipe:** Comply with Section 4020, 2.01.
  - c. **Reinforced Concrete Elliptical Pipe:** Comply with Section 4020, 2.01.
  - d. **Reinforced Concrete Low Head Pressure Pipe:** Comply with Section 4020, 2.01.
4. **Water Main:**
  - a. **Restrained Joint Ductile Iron Pipe:** Comply with Section 5010, 2.01.
  - b. **Restrained Joint PVC Pipe:** Comply with Section 5010, 2.01.

**2.02 CASING PIPE**

**A. Pipe:** Use only new, steel pipe meeting the requirements of ASTM A 139, Grade B; ASTM A 252, Grade 2; or ASTM A 53, Grade B. Pipe may be welded or seamless. Wall thickness will be as specified in the contract documents.

**B. Joints:**

1. Comply with American Welding Society Code D1.1. Weld all joints with full penetrating weld. Welders must be qualified according to Iowa DOT Article 2408.03, B. Welds must comply with Iowa DOT Materials I.M. 558.
2. Upon approval of the Engineer, an interlocking casing pipe connection system may be used in lieu of field welding the sections of casing pipe.

**2.02 CASING PIPE (Continued)**

- C. Pipe Diameter:** Minimum inside diameter as specified in the contract documents. If diameter is not specified, use a minimum inside casing diameter of at least 4 inches greater than the largest outside diameter of the carrier pipe, including pipe bells.

**2.03 CASING SPACERS**

- A. Use manufactured casing spacers to position carrier pipe in casing. Do not use wood skids.
- B. Meet the following material requirements:
1. HDPE Band/Panel and Riser: ASTM D 638.
  2. Stainless Steel or Carbon Steel Band/Panel and Riser: Type 304 stainless steel according to ASTM A 240 or carbon steel according to ASTM A 36.
    - a. Liner: Elastomeric PVC per ASTM D 149.
    - b. Spacer Skid/Runner: Abrasion resistant polymer with a low coefficient of friction.
    - c. Fasteners: Type 304 (18-8) stainless steel per ASTM A 193.

**2.04 BACKFILL FOR ABANDONED TUNNELS**

- A. Use Iowa DOT Class C concrete, approximately 4 inch slump.
- B. Flowable mortar, foamed cellular concrete, or CLSM according to Section 3010, 2.06.

**2.05 BACKFILL MATERIAL**

- A. Excavated Materials:** Comply with Section 3010 for classification of excavated materials. Use only suitable material for backfill material.
- B. Special Fill Materials:** For use where specified in the contract documents.
1. **PCC:** Use Iowa DOT Class C concrete, approximately 4 inch slump.
  2. **Flowable Mortar:** Comply with Section 3010, 2.06.
  3. **CLSM:** Comply with Section 3010, 2.06.
  4. **Foamed Cellular Concrete:** Comply with Section 3010, 2.06

**2.06 CASING END SEAL**

- A. Manufactured:** Minimum 1/8 inch thick manufactured synthetic rubber casing end seal with stainless steel bands and fasteners.
- B. PCC:** Comply with Section 6010. Do not use PCC casing end seals with flexible carrier pipes.

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**PART 3 - EXECUTION****3.01 EXCAVATION**

- A. Notify the Engineer prior to the start of excavation activities.
- B. Remove topsoil to a minimum depth of 12 inches and stockpile.
- C. Excavate the minimum size pits necessary to safely and properly perform the work.
  - 1. Protect existing facilities, trees, and shrubs during excavation.
  - 2. Place excavated material away from trench.
  - 3. Grade and shape spoil piles to drain and protect adjacent areas from runoff. Do not allow spoil piles to obstruct drainage. Stabilize stockpiles with seeding and provide sediment control around stockpiles.
- D. Remove rock, rubbish, debris, and other materials not suitable for use as backfill.

**3.02 SHEETING, SHORING, AND BRACING**

Comply with Section 3010, 3.03.

**3.03 DEWATERING**

Comply with Section 3010, 3.04.

**3.04 TRENCHLESS INSTALLATION**

- A. **General:** Select a method of installation that is appropriate for the soil conditions anticipated and will 1) allow the pipe to be installed to the desired line and grade within the specified tolerances; 2) prevent heaving or settlement of the ground surface or damage to nearby facilities; and 3) prevent damage to the carrier pipe and any lining materials within the carrier pipe.
  - 1. **Installation Methods:**
    - a. **Auger Boring:** A method that utilizes a rotating cutting head to form the bore hole and a series of rotating augers inside a casing pipe to remove the spoil.
    - b. **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 in place.
    - c. **Open-ended Pipe Ramming:** A method that involves 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.
    - d. **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.
    - e. **Microtunneling:** A method of pipe jacking using a remote controlled tunnel boring machine.
    - f. **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 in place.
    - g. **Other:** Other methods may be allowed with the Engineer's approval.

**3.04 TRENCHLESS INSTALLATION (Continued)****2. Line and Grade:**

- a. 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.
- b. When no deviation tolerances are specified in the contract documents, apply the following maximum deviations to the carrier pipe.
  - 1) Gravity Pipe:
    - a) Horizontally:  $\pm 1.0$  foot per 100 feet;
    - b) Vertically:  $\pm 0.2$  feet up to 100 feet; an additional  $\pm 0.1$  foot per 100 feet thereafter. Backfall in pipe is not allowed.
  - 2) Pressurized Pipe:
    - a) Horizontally:  $\pm 2.0$  feet
    - b) Vertically:  $\pm 1.0$  foot. Maintain the minimum depth specified in the contract documents.
- c. Greater deviation or interference with other identified facilities may be cause for rejection.

**3. Deviation from Line and Grade:**

- a. 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.
- b. 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.
- c. Abandon rejected installation and place special fill materials, at no additional cost to the Jurisdiction. Replace abandoned installations, including all additional fittings, manholes, or appurtenances required to replace rejected installations.

**B. Casing Pipe or Un-cased Carrier Pipe Installation:**

1. Install pipe by approved methods.
2. Use a jacking collar, timbers, and other means as necessary to protect the driven end of the pipe from damage.
3. Do not exceed the compressive or tensile strength capacity of the pipe during pushing or pulling operations.
4. Fully support bore hole at all times to prevent collapse. Insert pipe as soil is removed, or support bore with drilling fluid.
5. Fully weld all casing pipe joints. Use an interlocking connection system when approved by the Engineer.
6. Fill space between the inside of the bore hole and the outside of the pipe with special fill material if the space is greater than 1 inch.

**C. Carrier Pipe Installation through Casing:**

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

**3.04 TRENCHLESS INSTALLATION (Continued)**

2. Install casing spacers on carrier pipe sections as necessary to support the pipe barrel according to the pipe manufacturer's recommendations subject to the following minimum requirements:
    - a. Install a spacer within 1 foot of each side of the carrier pipe joint and at a maximum spacing of 6 feet.
    - b. Do not allow the pipe to be supported by joint bells.
    - c. Lubricate casing spacers with drilling mud or flax soap. Do not use petroleum-based lubricants or oils.
  3. Ensure that thrust loads will not damage carrier pipe joints. Provide thrust collars between joint shoulders of concrete pipe.
  4. 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.
  5. Position jacks so the resulting force is applied evenly to the entire end of the pipe.
  6. Assemble pipe joints in the jacking pit before pushing the carrier pipe into the casing.
  7. Close the end of the casing pipe around the carrier pipe with a casing end seal.
- D. Annular Space Grouting:** If specified, fill the annular space between the carrier pipe and the casing pipe with flowable mortar, foamed cellular concrete, or CLSM according to Section 3010. Batching, mixing, and placing may be started when the temperature is 34°F and rising. Cease mixing and placing when temperature is 38° F or less and falling.
1. **Flowable Mortar and CLSM:** Fill voids by staged grouting. Construct bulkheads at each end of the pipe. Ensure all voids are filled with flowable mortar by providing 2 feet of head when filling.
  2. **Foamed Cellular Concrete:**
    - a. Construct bulkheads sufficient to withstand pressure of grouting operation at each end of the pipe.
    - b. Use sufficient grouting pressures to ensure all voids between the inner pipe and the casing pipe have been filled without collapsing or deforming the inner pipe by more than 5% of the diameter. Multiple grout lifts may be necessary. Follow manufacturer's recommendations.
    - c. Check wet density at the beginning of the placement and a minimum of every 2 hours thereafter. Provide test results to the Engineer.
    - d. If grout holes are utilized, insert cylindrical wood plugs or other approved plugs until grout has set. Fill holes with concrete after plugs have been removed.

**3.05 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 3010, 3.05.
- C. Place suitable backfill material in the pit. Apply the testing requirements of Section 3010, 3.06.
- D. Restore the site to original condition or better.

END OF SECTION