

**SECTION 02910****BORING AND/OR JACKING PIPE****02910.01 GENERAL****A. Description**

Boring and/or jacking pipe shall include, but not necessarily be limited to, furnishing and installing carrier pipe without a casing pipe, or casing pipe beneath railways, roadways, or other locations indicated on the Plans and in accordance with the Contract Documents.

Installation and materials shall meet the requirements of the overlying railroad or highway owner where applicable. These requirements may supersede the requirements of this specification.

**B. Related Work Included Elsewhere**

1. Structure excavation; Section 02220.
2. Trench excavation, backfill, and compaction; Section 02250.
3. Excavation support; Section 02400.
4. Dewatering; Section 02512.
5. Storm drain installation; Section 02520.
6. Water main installation; Section 02551.
7. Sanitary sewer installation; Section 02561.
8. Sanitary sewer force main installation; Section 02563.

**C. Quality Assurance**

1. Qualifications
  - a. Use personnel thoroughly trained and experienced in skills required. Field supervisor of boring and jacking operations and tunneling machine operator to have not less than 12 months experience in operation of specific equipment to be used.
  - b. Make welds only by welders, tackers and welding operators previously qualified by tests as prescribed in Structural Welding Code AWS D1.1 to perform type of work required. Show proof of certification when requested by Engineer.
2. Materials

a. General

The Engineer will inspect all materials before and/or after installation to ensure compliance with the Contract Documents. When specific materials test are required by the referenced standards and specifications, the Engineer will have the option of requiring that any or all of these test be performed for materials furnished for a specific project. When testing is required, it will be specified in the "Special Provisions".

b. Steel Casing Pipe

Steel pipe shall be free from any visible defects or surface imperfections such as kinks, scars, or bends which may impair the performance or life of the pipe. Defects shall be considered injurious when the depth of the defect is greater than 12.5% of the nominal wall thickness. The pipe shall be substantially round. The outside circumference of the pipe shall not vary more than  $\pm 1\%$  from the nominal outside circumference based upon the diameter specified. The pipe shall not deviate by more than 1/8 inch from a 10 foot long straightedge held against the pipe. Defective or damaged coatings may be repaired in accordance with the coating manufacturer's written recommendations unless defect is large enough as to require rejection of the section in the judgement of the engineer.

c. Reinforced Concrete Pipe

Reinforced concrete pipe shall be free from fractures or cracks that extend through the wall of the pipe; surface defects indicating honeycomb or open texture; defects that indicate imperfect proportioning, mixing, and molding; damaged or cracked ends where such damage would prevent making a satisfactory joint; or any continuous crack having a surface width of 0.01 inch or more and extending for a length of 12 inches or more.

3. Detection of Movement

a. The Contractor shall install, maintain, make observations, and maintain a permanent record of his observations on a regular pattern of surface settlement markers as shown on the Plans or a plan approved by the Engineer. Settlement marker elevations shall be tied to benchmarks sufficiently remote as not to be affected by the construction operations.

b. The Contractor shall take at least 3 reading for each marker on three separate day prior to start of excavation to verify repeatability of readings. Pre-excavation readings shall be submitted and reviewed by the Engineer before start of excavation will be authorized.

- c. The Contractor shall monitor the movements of the indicators to an accuracy of +0.01 foot in accordance with readings taken on an approved schedule.
  - d. Prepare a plan showing locations of monitoring indicators and their designations. Maintain an electronic (spreadsheet) log of all readings, including the pre-excavation readings, The Contractor shall submit copies of the records to the Engineer as the Project progresses and logs shall be available to the Engineer for review at all times.
  - e. Whenever tunneling occurs within 50 feet of an indicator, the movements of the indicator shall be monitored before and after each advance of tunnel face within 50 feet of the indicator.
  - f. Unless established by the Contract Documents, Threshold displacement shall be 0.5” and Limit displacement shall be 1.0”. If a Threshold displacement is reached, Contractor shall immediately notify the Engineer to determine if any action is required. If a Limit displacement occurs, cease operations and ensure stable ground conditions, and immediately notify the Engineer to assess the need for corrective action. When directed by the Engineer, the Contractor shall take immediate remedial action, at no cost to the County.
  - g. When authorized by the Engineer and prior to final acceptance, remove subsurface monitoring equipment and casing to at least 2 feet below grade. Remove all surface monitoring stakes.
4. Field Tests and Inspection
- a. General

No testing will be conducted on bored and/or jacked casing pipe, installed in accordance with this Section, however the work will be visually inspected after installation by the Engineer prior to the installation of the carrier pipe.
  - b. Bored and/or Jacked Carrier and Casing Pipe
    - 1) Bored or jacked carrier pipe shall be installed to the line and grade indicated on the Plans to within a tolerance of 2 inches.
    - 2) Bored or jacked casing pipe shall be installed so as to provide a minimum concrete cradle thickness of 4 inches for the carrier pipe as indicated in the Contract Documents.

## c. Carrier Pipe

Carrier pipe will be inspected and/or tested in accordance with the applicable section or sections under which the remainder of the pipeline was installed.

- 1) Storm drain pipe will be inspected as specified in Section 02520.01.
- 2) Water mains will be inspected and tested as specified in Section 02551.01.
- 3) Sanitary sewers will be inspected and tested as specified in Section 02561.01.
- 4) Sanitary sewer force main will be inspected and tested as specified in Section 02563.01.

**D. Submittals**

## 1. Shop Drawings

- a. Shop drawings shall be submitted as specified in the "General Provisions" for the various types of pipe specified in Section 02910.02, including various pipe materials, casing spacers, casing end seals, as appropriate.

## 2. Work Plan

- a. The Contractor shall submit a Work Plan with Working Drawings for approval at least 4 weeks ahead of construction. The Work Plan approval is for the general arrangement and location of facilities and to demonstrate that the proposed work addresses the critical areas of concern. The tunneling means and methods are the responsibility of the Contractor.
- b. Work Plan shall include method of boring and advancing casing; size, capacity, and arrangement of equipment; a summary of the soils data; type of cutter head, method of dewatering; size and location of access shafts including method of excavation support; backstop materials and arrangement, pit base material; proposed method of monitoring and controlling line and grade; calculations or jacking forces, backstop design, and casing pipe design. Calculations for support of excavation shall be submitted if design is not included in Contract Documents.
- c. Work plan shall also include proposed method of installing and supporting the carrier pipe within the casing and to prevent flotation of the carrier pipe.

- d. Boring/jacking work shall not proceed until drawings have been reviewed and returned by the Engineer.
3. Certificates of Compliance

Certificates of compliance shall be submitted in accordance with the "General Provisions" for pipe and bituminous coatings specified in Section 02910.02. The certificate shall state that the item furnished has been manufactured in accordance with and meets the requirements of the standard referenced.

## **02910.02 MATERIALS**

### **A. Materials Furnished by the County**

The County will not furnish any materials for boring and/or jacking pipe.

### **B. Contractor's Options**

None.

### **C. Detailed Material Requirements**

1. Portland Cement Concrete

Portland cement concrete for inverts or cradles shall be Mix No. 2 as specified in Section 03310.
2. Mortar for Grout

Mortar used for grouting voids outside the casing or carrier pipe shall conform to the requirements of Section 04100 except that it shall be composed of one part Portland cement and three parts sand.
3. Steel Casing Pipe
  - e. Steel casing pipe shall be smooth walled and have a minimum yield strength of 36,000 psi (ASTM A-1011 Grade 36). Pipe diameter shall be per the Contract Documents although Contractor may request modification to the casing diameter to suit his equipment, subject to approval by the Engineer. Minimum wall thickness shall be as specified in the Contract Documents. Pipe may have factory longitudinal or circumferential welds. Spiral welds are prohibited.
  - f. The pipe shall be joined by full penetration butt welds of sufficient strength to withstand installation and earth loads without distortion of the pipe. Welds shall be performed by qualified welders as specified in Section 02910.01 C.1.2.

- g. The exterior of the pipe including field connections shall be bituminous coated before installation. Bituminous coating shall be Carbolite Bitumastic 300M or Tnemec 46H-413 Hi-Build; or equal. Minimum thickness and application shall be per the Manufacturer's specifications.
- h. Casing pipe shall be fitted with 1-1/2 inch diameter grout ports and plugs as indicated on the Contract Documents.

#### 4. Reinforced Concrete Casing Pipe

- a. Reinforced concrete casing pipe shall meet the requirements of ASTM C76 and AASHTO M170, except the pipe shall be Class V, and shall be of wet cast construction. Joints shall have smooth exterior profile with an external steel joint band. Joints shall include an integral rubber gasket conforming to ASTM C443 and shall be designed to withstand up to 50 psi.
- b. Materials and finished product testing shall be in accordance with AASHTO M 170 and ASTM C76, and as specified herein.

#### 5. Carrier Pipe

- a. Carrier pipe to be installed by Jacking may be Steel or RCP, as specified in Sections 02520.02, 02551.02, 02561.02, or 02563.02 as appropriate, except pipe designed specifically for jacking shall be provided.
- b. Carrier pipe to be installed in casing shall be as specified in the Contract Documents and meet the requirements specified in Sections 02520.02, 02551.02, 02561.02, or 02563.02 as appropriate. The carrier pipe shall be restrained joint pipe.

#### 6. Casing Spacers

- a. Bands and Risers
  - 1) Minimum 2 pieces, Type 304 stainless steel plate.
  - 2) Band: Minimum thickness: 12 gauge.
- b. Runners
  - 1) Ultra high molecular weight (UHMW) polyethylene or polymer reinforced fiberglass with DURO Hardness A of 80 and minimum dielectric strength of 500 volts per mil with sufficient compressive and shear strengths to support the carrier pipe and contents. Runner ends shall be beveled.

- 2) Attach to risers with bolts or welded studs. All fasteners shall be Type 304 stainless steel.
    - 3) Fill bolt holes with silicone caulk.
  - c. Spacer Band: Minimum 12-inch width. Line with minimum 0.090 inch thick ribbed PVC liner of DURO Hardness A of 80 and minimum dielectric strength of 50,000 volts per mil. Liner shall include retaining ridge that extends over the band to prevent slipping of the liner during installation.
  - d. Submit Spacer data for materials, load capacity, load calculations, and shop drawing showing spacer dimensions, riser positions and riser/runner dimensions.
  - e. Approved Manufacturers:
    - 1) Pipeline Seal and Insulator Inc., Model S.
    - 2) Cascade Waterworks Manufacturing Company, Style CCS.
    - 3) Or equal (Minimum 5 years of fabricating casing spacers in the United States).
7. Manufactured Casing End Seals
  - a. Where manufactured End Seals are shown or approved, Approved Manufacturers:
    - 1) Advance Products & Systems, Model AC or AM
    - 2) Pipeline Seal & Insulator, Inc., Model S or C.
    - 3) Maloney Technical Products, MULTIFLEX End Seal.
    - 4) Or equal.
8. Surface Settlement Markers
  - a. Surface settlement markers within pavement areas shall be P.K. nails.
  - b. Surface settlement markers within non-paved areas shall be wooden hubs.
9. Subsurface Settlement Indicators
  - a. Subsurface settlement indicators shall be fabricated of 2-1/2 inch diameter steel pipe casing, an inner 1 inch diameter extra strong steel pipe with a pipe cap, and 1/4 inch diameter round head stainless steel bolt as directed

by the Engineer. Fabricate in accordance with the Standard Details or as shown on Contract Documents.

### **02910.03 EXECUTION**

#### **A. Preparation**

1. Review and evaluate geotechnical data and/or investigate site soil conditions before performing work and equipment selection.
2. Preliminary work shall consist of excavating and sheeting a suitable launch and reception shaft on each side of the crossing, installation of a backstop, setting and aligning the jacking frame, and setting the boring machine.
3. Install settlement monitoring markers and devices and establish stable, protected reference survey benchmarks.

#### **B. Shaft Construction**

1. Excavate shafts following working drawings. Follow OSHA requirements for ingress and egress.
2. Provide shaft floor or subgrade to ensure sound and stable equipment support throughout the tunneling operation.
3. Provide sumps or other means for dewatering to keep excavation free of water and prevent impact to support of tunnel equipment.
4. Backstop shall be constructed in Launch Shaft and shall be designed to support the maximum jacking force of the equipment to be used.
5. Provide means for launch of boring operation while maintaining soil support.
6. After completion of carrier pipe installation, backfill shafts and remove excavation support unless directed to leave in place by Contract Documents. For carrier pipe installed in shafts, provide approved overcut backfill material beneath carrier pipe to solid subgrade.

#### **C. Boring and/or Jacking**

1. Equipment shall include means to monitor line and grade of tunnel excavation.
2. When augers or similar devices are used for pipe emplacement, the front of the pipe shall be provided with mechanical arrangements or devices that will positively prevent the auger and cutting head from leading the pipe so that there will be no unsupported excavation ahead of the pipe. The arrangement shall be removable from within the pipe in the event an obstruction is encountered. The



excavation by the cutting head shall not exceed the outside diameter of the pipe by more than 1/2 inch. The face of the cutting head shall be arranged to provide reasonable obstruction to the free flow of soft or sandy soils.

3. The use of water or other liquids to facilitate casing emplacement and spoil removal is prohibited.
4. If an obstruction is encountered during installation that stops the forward action of the pipe, and it becomes evident that it is impossible to advance the pipe, operations shall cease and the casing pipe shall be abandoned in place and filled completely with grout.
5. Cutting head shall overcut shall not exceed the outside diameter of the casing pipe by 0.5 inches. If voids should develop or if the bored hole diameter is greater than the outside diameter of the pipe by more than approximately 0.5 inches, grouting or other methods approved by the Engineer shall be employed to fill such voids.
6. When water is known or expected to be encountered, pumps of sufficient capacity to handle the flow shall be maintained at the site. The pumps shall be in constantly attended operation on a 24-hour basis until, in the sole judgment of the Engineer, their operation can be safely halted. When dewatering, close observation shall be maintained to detect any settlement or displacement of surface facilities. Should settlement or displacement be detected, the Contractor shall notify the Engineer immediately and take such action as necessary to maintain safe conditions and prevent any further damage.
7. All operations shall be conducted so as not to interfere with, interrupt, or endanger the operation of traffic, or damage, destroy, or endanger the integrity of any surface facilities.
8. The procedure outlined above will also apply to installations where excavation with mechanical augers are used in casings smaller than 30-inch diameter, except there is no overcut or contact grouting required under normal circumstances.
9. Should contact grouting be required due to excessive overcut or loss of material at tunnel face, follow grouting procedures as specified in Section 02920.03 I., Gravel Packing and Contact Grouting.
10. Maintain line and grade to within 2 inches of design or as specified in the Contract Documents.

#### **D. Installation of Carrier Pipe**

1. Except where Carrier pipe is installed by Boring and/or Jacking, Carrier pipe shall be installed within the casing pipe as shown in the Contract Documents and as specified in Sections 02520.03, 02551.03, 02561.03, and 02563.03.

2. Provide casing spacers or other means as shown on the Contract Documents to support and prevent movement of the carrier pipe within the casing.
3. If required by Contract Documents, provide concrete cradle in casing pipe to support carrier pipe.
4. Where shown or specified in the Contract Documents, the annular space between the casing and carrier pipes shall be filled with Portland cement concrete or grout. Materials shall be as specified in Sections 03310 and 03600.

**E. Casing End Seals**

1. Install casing end seals as required by the Contract Documents. If casing is to be filled with grout after installation of carrier pipe, end seals shall be of brick and mortar, and shall include piping connections necessary to permit grout fill and air/water release.
2. If manufactured end seal products are used, install in accordance with manufacturer's requirements.

**02910.04 METHOD OF MEASUREMENT****A. Casing Pipe**

1. Measurement for bored and/or jacked casing pipe will be made of the length of casing pipe satisfactorily installed. Measurement will be made horizontally along the centerline of the pipe between the inside faces of the boring pit.
2. Carrier pipe will be measured as specified in Sections 02520.04, 02551.04, 02561.04, and 02563.04 as appropriate.

**B. Carrier Pipe installed by Boring and/or Jacking**

Measurement for bored and/or jacked carrier pipe will be made of the length of carrier pipe satisfactorily installed. Measurement will be made horizontally along the centerline of the pipe to 5 feet inside the face of each shaft unless otherwise indicated in the Contract Documents.

**02910.05 BASIS OF PAYMENT****A. General**

Payment will be made at the unit prices bid. The prices bid shall include the excavation, support, backfill, compaction, and restoration of the boring and receiving pits; removal and disposal of excess excavated material; dewatering; settlement monitoring; furnishing and placing Portland cement concrete and/or grout; and the furnishing of all labor,

equipment, tools, and incidentals necessary to complete the installation as shown, and as specified in strict accordance with the Contract Documents, and accepted by the Engineer.

**B. Bored and/or Jacked Pipe**

1. Payment for bored and/or jacked casing or carrier pipe will be made per linear foot for the various diameters of pipe furnished and installed by boring and/or jacking.
2. The prices bid shall include the installation and removal of tunneling equipment, installation and removal of equipment support materials, removing and disposing excess excavated material; furnishing and installing pipe; dewatering; settlement monitoring; furnishing and placing gravel fill and contact grout; and the furnishing of all engineering, labor, equipment, tools, and incidentals necessary to complete the installation as shown and as specified in strict accordance with the Contract Documents and accepted by the Engineer.

**C. Shafts**

1. Payment for Tunnel Shafts shall be at the Lump Sum price bid for the launch and receiving shafts associated with each tunnel installation.
2. The price shall include the excavation, support, backfill, compaction, and restoration of the access shafts; removing and disposing excess excavated material; dewatering; and the furnishing of all engineering, labor, equipment, tools, and incidentals necessary to complete the installation as shown and as specified in strict accordance with the Contract Documents, and accepted by the Engineer.
3. Shaft price shall also include furnishing and installing casing end seals.

**D. Carrier Pipe**

1. Payment for carrier pipe installed within the casing will be made per linear foot of the particular size of pipe installed, unless specified otherwise in the Contract Documents.
2. The prices shall include furnishing and installing the carrier pipe including all supports, skids, casing spacers, restraints, testing as required in Sections 02520.02, 02551.02, 02561.02, or 02563.02 as appropriate, and furnishing of all engineering, labor, equipment, tools, and incidentals necessary to complete the carrier pipe installation as shown and as specified in strict accordance with the Contract Documents, and accepted by the Engineer.
3. If required by the Contract Documents, the price shall include furnishing and installing the annular grout or cast-in-place concrete cradle.

END OF SECTION