

## SECTION 02315

### BORING, JACKING AND TUNNELING

#### PART 1. GENERAL

##### 1.01 RELATED SECTIONS

- A. Section 02151 - Shoring
- B. Section 02225 - Excavating, Backfilling and Compacting for Utilities
- C. Section 02600 - Utility Piping
- D. Section 03300 - Cast-in-Place Concrete

##### 1.02 QUALITY ASSURANCE

- A. Provide work in this section in accordance with these specifications and the Standard Detail Drawing Nos. 16 & 17.
- B. Workmen Qualifications:
  - 1. Use only personnel thoroughly trained and experienced in the skills required.
  - 2. Welds shall be made only by welders, tackers, and welding operators who have been previously qualified by tests as prescribed in the Structural Welding Code AWS D1.1 of the American Welding Society to perform the type of work required.
- C. Design Criteria:
  - 1. Encasing conduit under highways shall be of sufficient strength to support all superimposed loads including an American Association of State Highway and Transportation Officials H-20 Loading with fifty (50) percent added for impact.
  - 2. Design and execution in railroad rights-of-way shall comply with all requirements of the Railroad Company.
- D. Requirements of Regulatory Agencies:
  - 1. Work of this Section within State Highway right-of-way will be subject to inspection by representatives of the Commonwealth of Pennsylvania Department of Transportation and the work must be performed in accordance with the requirements of the latest edition of the Commonwealth of Pennsylvania, Pennsylvania Code, Title 67, Transportation, Department of Transportation, Chapter 459, Occupancy of Highways by Utilities.
  - 2. Work of this Section within the railroad right-of-way will be subject to the inspection of representatives of the Railroad Company and all work and materials must be in accordance

with their requirements.

3. Work in the Railroad rights-of-way shall conform to Specifications for Pipeline Occupancy of Railroad Company Property and the specifications of the American Railway Engineering Association.

E. Source Quality Control:

1. Shop Tests: The Engineer reserves the right to require the contractor to perform such tests as the Engineer may deem necessary to establish the quality of the material offered for use.

<u>MATERIAL</u>	<u>TEST METHOD</u>	<u>NUMBER OF TESTS</u>
Steel Pipe	ASTM A-139	As specified in ASTM A-139 or ASTM A-53
	ASTM A-53	As applicable

2. Laboratory Tests: The Engineer reserves the right to require that laboratory tests also be conducted on materials that are shop tested.

1.03 REFERENCES

- A. American Association of State Highway and Transportation Officials (H-20): (AASHTO) Loading for Conduits Installed Under Streets, Roads, or Highways.
- B. American Society for Testing and Materials:
  1. ASTM A-53, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
  2. ASTM A-139, Specification for Electric-Fusion (Arc) - Welded Steel Pipe (NPS 4 in. and over).
  3. ASTM C-32, Specification for Sewer and Manhole Brick (Made from Clay or Shale).
  4. ASTM C-33, Specification for Concrete Aggregates.
  5. ASTM C-150, Specification for Portland Cement.
  6. ASTM C-270, Specification for Mortar for Unit Masonry.
- C. American Welding Society: AWS D1.1 Structural Welding Code.
- D. Commonwealth of Pennsylvania, Department of Transportation (PennDOT), Specifications Publication 408, as supplemented.
  1. Section 703.2, Coarse Aggregate.
- E. State Code: Commonwealth of Pennsylvania Code, Pennsylvania Title 67. Transportation, Department of Transportation.
  1. Chapter 459, Occupancy of Highways by Utilities, January, 1982.

2. Chapter 203, Work Zone Traffic Control.

1.04 SUBMITTALS

- A. Shop Drawings and Product Data: Furnish completely dimensioned shop drawings, cuts, or other data as required to provide a complete description of Products to be installed.
- B. Certificates: Certified records or reports of results of shop tests, such records or reports to contain a sworn statement that shop tests have been made as specified.
- C. Furnish to PennDOT, for approval detail drawings, accompanied by design calculations for boring or jacking pits including sheeting and bracing thereof, steel pipe and boring or jacking procedure, and grouting method and all such drawings and computations shall bear the seal of a Registered Professional Engineer licensed to practice in Pennsylvania.
- D. Furnish to Authority for approval by Railroad Company detail drawings, accompanied by design calculations, for boring or jacking pits including sheeting and bracing thereof, steel pipe and boring or jacking procedure and grouting methods and all such drawings and computations shall bear the seal of a Registered Professional Engineer licensed to practice in Pennsylvania.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Transport, handle and store materials and Products specified herein in a manner recommended by the respective manufacturers of such to prevent damage and defects.

1.06 SITE CONDITIONS

- A. Classification of Materials:
  - 1. Highway Crossing Boring, Tunneling or Jacking: No consideration will be given to the nature of materials encountered in the boring, tunneling or jacking for Highway Crossing. Remove rock encountered during the boring, tunneling or jacking operation.
- B. Scheduling:
  - 1. Perform boring, tunneling or jacking operations continuously on a 24-hour basis if required by PennDOT.
- C. Environmental Requirements:
  - 1. As specified in Section 02151 and 02225.
- D. Protection: As specified in Section 02225, 02270, and such added requirements included herein.
  - 1. Adequately support and protect utilities and facilities that are encountered in, or may be affected by, the Work.
  - 2. Structure Supports: As specified in Section 02225.
  - 3. Accommodation of Traffic: As specified in Section 02225.

4. Explosives and Blasting: Not permitted in performance of work of this Section.
5. Excavation Conditions: As specified in Section 02225.

## PART 2. PRODUCTS

### 2.01 ENCASING CONDUIT (PennDOT Work)

- A. Steel Pipe: ASTM A-139, Grade B or ASTM A-53, Grade B.
  1. Minimum Diameter: As shown on the Drawings.
  2. Minimum Wall Thickness: 0.500 inch.

### 2.02 TUNNEL LINER PLATE (PennDOT Work)

- A. Plates: Unless otherwise indicated on the Drawings, proposed sizes and thickness of plates shall be submitted to the Engineer along with shop drawings for approval. In no event shall the liner plate thickness be less than 0.1046 inches. All plates shall be formed from one piece of metal to provide longitudinal and circumferential flanges. The shape of the plates shall be such that erection and assembly of the liner plate structure can be completely and readily effected from inside the tunnel.
  1. Plates shall be accurately curved to suit the tunnel cross sections and all dimensions shall be of such size and accuracy that plates of similar curvature will be interchangeable. All plates shall be connected by bolts on both the longitudinal and circumferential joints.
  2. The tunnel liner plates shall be fabricated from structural quality, hot rolled steel, suitable for cold forming in closed dies and shall conform to ASTM A-570, Grade B for sheets or ASTM A-283, Grade B for plates.
  3. The tunnel liner plates shall be galvanized to meet AASHTO M 167 specifications and shall be bituminous coated to meet AASHTO M 190 specifications. Such coating to be a minimum thickness of 0.05 inches.
- B. Bolts and Nuts: Bolts and nuts shall be not less than ½ inch in diameter for 7 gauge plates and lighter, and not less than 5/8 inch diameter for liner plates heavier than 7 gauge. They shall be quick-acting coarse thread and conform to ASTM A-307, Grade A. The nuts and bolts shall be hot dip galvanized to conform to ASTM A-153.

### 2.03 SEWER PIPE AND FITTINGS (PennDOT Work)

- A. Ductile Iron Pipe: As specified in Section 02600.

### 2.04 MISCELLANEOUS MATERIAL

- A. Concrete: As specified in Cast-in-Place: Section 03300.
  1. Class B: 3000 psi.
- B. Aggregate Backfill:

1. AASHTO No. 8 Coarse Aggregate conforming in PDT Pub. 408, Section 703.2.
- C. Brick: Commercially manufactured brick made from clay or shale and burned, meeting requirements of ASTM C-32, Grade MS.
- D. Mortar: Material composition meeting requirements of ASTM C-270, Type M with waterproofing admixture included.
1. Medusa Cement Company; Medusa Waterproofing Paste or Powder.
  2. Grace Construction Materials; Hydratite.
  3. Chem-Master Corporation; Hydrolox.
  4. Or Equal.
- E. Grout (Sand/Cement):
1. Portland Cement: ASTM C-150, Type II.
  2. Sand: ASTM C-33, fine aggregate.
  3. Water: Potable.
  4. Grout Quality: Mixture of one part Portland Cement, three parts fine aggregate and water.
- F. Sand: ASTM C-33, fine aggregate.

2.05 CONTRACTOR OPTIONS IN PRODUCTS

- A. The Contractor may install a larger diameter encasing conduit than is shown on the Drawings provided that the Contractor has secured the prior written approval of the applicable agencies having jurisdiction. If the Contractor elects to install a larger diameter encasing conduit than is shown on the Drawing, all necessary clearances under the roadways, pipelines or other structures shall be maintained. Substitution of a larger diameter encasing conduit will be made without additional compensation over the price bid.

PART 3. EXECUTION

3.01 INSPECTION

- A. Inspect Materials and Products before installing in conformance with the inspection requirements of the appropriate referenced standard.
- B. Remove rejected Materials and Products from the Project.

3.02 PREPARATION

- A. As specified in Section 02225.

3.03 PERFORMANCE (PennDOT Work)

- A. Excavation: As specified in Section 02225 and such added requirements included herein:
  - 1. Should the Contractor, in constructing any boring or jacking pit, excavate below the subgrade for the pipe sewer, he will be required to backfill the area excavated below the subgrade with Aggregate Backfill or with concrete as required by the Engineer at his own expense and at no additional cost to the Owner.
- B. Boring:
  - 1. Boring shall conform to the applicable requirements of the regulatory agency and additional requirements specified herein.
    - a. Install the encasing conduit by the boring method to the limits indicated on the Drawings or such additional limits required by the Engineer or regulatory agency.
    - b. Excavate and sheet boring pit.
    - c. Provide devices at the front of the pipe to prevent auger and cutting heads from leading the encasing conduit. Unsupported excavation ahead of pipe is prohibited.
    - d. Over-cut by cutting head not to exceed the outside diameter of the encasing conduit by more than one-half (1/2) inch.
    - e. The use of water or other liquids to facilitate casing placement and spoil removal is prohibited.
    - f. If voids develop or if bored hole diameter is more than one (1) inch greater than the outside diameter of the encasing conduit, place Grout to fill voids.
    - g. Check conduit alignment in a manner and at times required by Engineer. Check alignment and grade at least once per shift as the work progresses.
    - h. Completely bulkhead heading at interruptions in boring operation.
    - i. Completely weld joints around the circumference between sections of steel pipe encasing.
- C. Jacking:
  - 1. Jacking shall conform to all applicable requirements of the regulatory agencies and additional requirements specified herein. This operation shall be conducted without hand mining ahead of the pipe and without the use of any type of boring, augering, or drilling equipment.
    - a. Install the encasing conduit by the jacking method to the limits indicated on the Drawings or such additional limits required by the Engineer or the regulatory agencies.
    - b. Preliminary work shall consist of excavating and sheeting an acceptable shaft on the downstream side of the crossing and the installation of a backstop and guide timbers.

- c. Design: Bracing and backstops shall be so designed and jacks of sufficient rating used so that the jacking can be progressed without stoppage except for adding lengths of pipe.
- d. Accurately place guide timbers on line and grade.
- e. Support: The vertical face of the excavation shall be supported as necessary to prevent sloughing.
- f. Use poling boards and bulkheads as required if subgrade conditions in the heading are unstable.
- g. Jacking and excavation within the pipe shall proceed simultaneously with the ground being cut no more than two (2) inches outside the pipe at the top and sides and not less than two (2) inches above subgrade at the bottom.
- h. The use of water or other liquids to facilitate casing placement and spoil removal is prohibited.
- i. If voids develop or if jacked hole diameter is more than one (1) inch greater than the outside diameter of the encasing conduit, place grout to fill voids in manner approved by the regulatory agencies.
- j. Check conduit alignment in a manner and at times required by Engineer. Check alignment and grade at least once per shift as the work progresses.
- k. Completely bulkhead heading at interruptions in jacking operation.
- l. Completely weld joints around the circumference between sections of steel pipe encasing.

D. Tunneling:

- 1. Liner plates shall be assembled in accordance with the manufacturer's instructions.
- 2. Care shall be exercised in trimming the surface of the excavated section in order that the steel liner plates fit snugly against undisturbed material.
- 3. Excavation shall not be advanced ahead of the previously installed liner plates any more than is necessary for the installation of the succeeding liner plates.
- 4. The vertical face of the excavation shall be supported as necessary to prevent sloughing.
- 5. At any interruption of the tunneling operation, the heading shall be completely bulkheaded.
- 6. Unless otherwise approved by the Engineer, the tunneling shall be conducted continuously, on a 24-hour basis, until the tunnel liners extend at least three (3) feet beyond the edge of the shoulder or the distance specified by the permit.

- E. Grouting:
1. A uniform mixture of sand cement grout shall be placed under pressure behind the liner plates to fill any voids existing between the liner plates and the undisturbed material.
  2. Grout holes tapped for no smaller than 1-1/2 inch pipe, spaced at approximately three (3) feet around the circumference of the tunnel liners, shall be provided in every third ring.
  3. Grouting shall start at the lowest hole in each grout panel and proceed upwards simultaneously on both sides of the tunnel.
  4. A threaded plug shall be installed in each grout hole as the grouting is completed at that hole.
  5. Grouting shall be kept as close to the heading as possible using grout stops behind the liner plates if necessary. Grouting shall proceed as directed by the Engineer but in no event shall more than six (6) linear feet of tunnel be progressed beyond the grouting.
- F. Laying and Testing Pipe: Lay and test pipe in encasing conduit as specified in Section 02600 and such added requirements included herein.
1. Support and maintain the alignment and grade of sewer piping until the concrete cradle is installed and concrete has cured.
  2. Provide concrete cradle as indicated on Standard Detail Drawing Nos. 17 and 18. Concrete construction as specified in Section 03300.
  3. Pressure treated wood blocking of the carrier pipe will be permitted as an alternative to concrete cradles.
- G. Encasing Conduit Filling and Closing: After the pipe sewer has been installed in the encasing conduit and has been tested, fill the encasing conduit with sand.
1. Close one end of encasing conduit with brick and mortar before filling encasing conduit. Close other end of encasing conduit with brick and mortar after filling encasing conduit or as operation dictates.
- H Cleanup: As specified in Section 02225.

3.04 FIELD QUALITY CONTROL

- A. Testing: After laying pipe in encasing conduit and before filling conduit, conduct line acceptance testing as specified in Section 02651.