

Section 02628

JACKING PIPE OR BOX

1.0 GENERAL

1.01 SECTION INCLUDES

A Description-Furnish and install pipe or box by jacking.

B Direct Jacking

Direct jacking of concrete box is a method of installing a Precast Reinforced Concrete Box (RCB) under roadways, railways, runway or highways in lieu of the open cut method. The box jacking procedure uses a PIPE OR BOX that is suitable to be jacked through the soil; sizes range from an end area of approximately 32 square feet to 144 square feet (8' x 4' to 12' x 12'). Maximum jacking loads are controlled by pumping bentonite or suitable lubricants around the outside of the box during the jacking operation. Typically, jacks are oversized so they can be operated at a lower pressure and maintain a reserve jacking capacity. It is common, although not mandatory, to use a 24-hour operation when pushing box, reducing the possibility that the box will freeze or "set" in the ground.

C References to Technical Specifications:

1. Section 01200 – Measurement and Payment Procedures
2. Section 01350 – Submittals
3. Section 01450 – Testing Laboratory Services
4. Section 02255 – Bedding, Backfill, and Embankment Materials
5. Section 02318 – Excavation and Backfill for Utilities
6. Section 02415 – Augering Pipe or Casing for Sewers
7. Section 01140 – Contractor's Use of Premises

D Referenced Standards:

1. American Society for Testing and Materials (ASTM)
2. ASTM C 76, "Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
3. ASTM C 443, "Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets"
4. ASTM C 506, "Standard Specification for Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe"
5. ASTM C 877, "Standard Specification for External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections"
6. ASTM C 507, "Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe"
7. ASTM C 655, "Standard Specification for Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe"
8. ASTM D 3350, "Standard Specification for Polyethylene Plastic Pipe and Fittings Materials"

9. ASTM C 1433, "Standard Specification for Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers"
10. ASTM B 633, "Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel"
11. ASTM A 760, "Standard Specification for Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains"
12. American Association of State Highway and Transportation Officials (AASHTO)

1.02 MEASUREMENT AND PAYMENT

- A Measurement for storm sewers is on a linear foot basis taken along the center line of the pipe from center line to center line of manholes or from end to end of culverts, measured and complete in place. Separate measurement will be made for each type and size of pipe installed.
- B Payment for storm sewer includes pipe, earthwork, connections to existing manholes and pipe, accessories, equipment and execution required or incidental to storm sewer work.
- C Refer to Section 01200 – Measurement and Payment Procedures.

1.03 SUBMITTALS

- A Make Submittals required by this Section under the provisions of Section 01350 – Submittals.
- B Tunnel specialist to be performing the work on the job must submit a letter of qualification to the Owner outlining:
 1. A successful history of direct jacking box;
 2. Have successfully completed direct jack installations of equal or greater size and length;
 3. Direct jack installation of pipe or box has been completed within the last two years;
 4. List of Project Names and Owners with contact information for projects qualifying the Tunnel specialist.
- C Submit manufacturer's literature for product specifications and installation instructions.
- D Submit product quality, material sources, and field quality information in accordance with this Section.

1.04 QUALITY ASSURANCE

- A The condition for acceptance will be a storm sewer that is watertight both in pipe-to-pipe joints and in pipe-to-manhole connections.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

- A Comply with manufacturer's recommendations.

- B Handle pipe, fittings, and accessories carefully with approved handling devices. Do not drop or roll pipe off trucks or trailers. Materials cracked, gouged, chipped, dented, or otherwise damaged will not be approved for installation.
- C Store pipe and fittings on heavy timbers or platforms to avoid contact with the ground.
- D Unload pipe, fittings, and specials as close as practical to the location of installation to avoid unnecessary handling.
- E Keep interiors of pipe and fittings completely free of dirt and foreign matter.

2.0 PRODUCTS

2.01 PIPE MATERIAL

- A Reinforced Concrete Box Must be “Jacking Quality” designed to withstand estimated jacking loads; Boxes with an end area greater than 50 square feet should be no longer than six (6) foot in length.
- B Joint Cushions: Use ¾” minimum thickness plywood cushions or other approved material; Use cushioning rings of single or multiple pieces.
- C Piping materials for storm sewers shall be of the sizes and types indicated on the Plans.
- D Materials for pipe and fittings, other than those specified or referenced, may be considered for use in storm sewers.
- E For consideration of other materials, submit complete manufacturer's data including materials, sizes, flow carrying capacity, installation procedures, and history of similar installations to Engineer for pre-bid evaluations, if allowed, or as a substitution.

2.02 REINFORCED CONCRETE PIPE

- A Circular reinforced concrete pipe shall conform to requirements of ASTM C 76, for Class III wall thickness. Joints shall be rubber gasketed conforming to ASTM C 443.
- B Reinforced concrete arch pipe shall conform to the requirements of ASTM C 506 for Class A-III. Joints shall conform to ASTM C 877.
- C Reinforced concrete elliptical pipe, either vertical or horizontal, shall conform to the requirements of ASTM C 507 for Class VE-III for vertical or Class HE-III for horizontal. Joints shall be rubber gaskets conforming to ASTM C 877.
- D Reinforced concrete D-load pipe shall conform to the requirements of ASTM C 655.
- E When approved by the Engineer, high density polyethylene, corrugated drainage pipe meeting requirements of AASHTO M252 or M294 and ASTM D 3350, Hancor or equal.

2.03 PRECAST REINFORCED CONCRETE BOX SEWERS

- A All box sewer sections shall conform to ASTM C1433, as indicated on the Plans.
- B All pipe and boxes shall be machine-made or cast by a process which will provide for uniform placement of concrete in the forms and compaction by mechanical devices which will assure a dense concrete.
- C Concrete shall conform to requirements of Section 03300 – Cast-in-Place Concrete.
- D Concrete shall be mixed in a central batch plant or other batching facility from which the quality and uniformity of the concrete can be assured. Transit-mixed concrete is not acceptable.

2.04 CORRUGATED METAL PIPE AND FITTINGS

- A Corrugated metal pipe may be galvanized steel, aluminized steel, aluminum or precoated galvanized steel as indicated on Plans and conforming to the following:

Galvanized Steel	AASHTO M218
Aluminized Steel	AASHTO M274
Aluminum	AASHTO M197
Precoated Galvanized Steel	AASHTO M246

 - 1. Reference to gauge of metal is to U.S. Standard Gauge for uncoated sheets. Tables in AASHTO M218 and AASHTO M274 list thicknesses for coated sheets in inches. The tables in AASHTO M197 list thicknesses in inches for clad aluminum sheets.
- B Coupling bands and other hardware for galvanized or aluminized steel pipe shall conform to requirements of AASHTO M36 for steel pipe and AASHTO M196 for aluminum pipe.
 - 1. Coupling bands shall be not more than 3 nominal sheet thicknesses lighter than thickness of pipe to be connected and in no case lighter than 0.052 inch for steel or 0.048 inch for aluminum.
 - 2. Coupling bands shall be made of same base metal and coating (metallic or otherwise) as pipe.
 - 3. Minimum width of corrugated locking bands shall be as shown below for corrugations which correspond to end circumferential corrugations on pipes being joined:
 - a. 10 ½ inches wide for 2 ⅔ inch x 1/2-inch corrugations.
 - b. 12 inches wide for 3 inch x 1 inch corrugations.
 - 4. Helical pipe without circumferential end corrugations will be permitted only when it is necessary to join a new pipe to an existing pipe which was installed with no circumferential end corrugations. In this event pipe furnished with helical corrugations at ends shall be field jointed with either helically corrugated bands or with bands with projections (dimples). The minimum width of helical corrugated bands shall conform to the following:
 - a. 12 inches wide for 1/2 inch-deep helical end corrugations.
 - b. 14 inches wide for one inch-deep helical end corrugations.

5. Bands with projections shall have circumferential rows of projections with one projection for each corrugation. Width of bands with projections shall be not less than the following:
 - a. 12 inches wide for pipe diameters up to and including 72 inches. Bands shall have two circumferential rows of projections.
 - b. 16 ¼ inches wide for pipe diameters of 78 inches and greater. Bands shall have four circumferential rows of projections.
 6. Bolts for coupling bands shall be 1/2 inch diameter. Bands 12 inches wide or less will have a minimum of 2 bolts per end at each connection, and bands greater than 12 inches wide shall have a minimum of 3 bolts at each connection.
 7. Galvanized bolts may be hot dip galvanized in accordance with requirements of AASHTO M 232, mechanically galvanized to provide same requirements as AASHTO M 232, or electro-galvanized per ASTM B 633, Type RS.
- C Bituminous coated pipe or pipe arch shall be coated inside and out with a bituminous coating which shall meet these performance requirements and requirements of AASHTO M190.
1. Pipe shall be uniformly coated inside and out to a minimum thickness of 0.05 inch, measured on crests of corrugations.
 2. Bituminous coating shall adhere to the metal so that it will not chip, crack, or peel during handling and placement; and shall protect pipe from corrosion and deterioration.
 3. Where a paved invert is shown on Plans, pipe or pipe arch, in addition to fully-coated treatment described above, shall receive additional bituminous material, same as specified above, applied to the bottom quarter of circumference to form a smooth pavement. Maintain a minimum thickness of 1/8 inch above crests of corrugations.
- D Furnish all fittings and specials required for bends, end sections, branches, access manholes, and connections to other fittings. Design fittings and specials in accordance with Plans and ASTM A 760. Fittings and specials are subject to same internal and external loads as straight pipe.

3.0 EXECUTION

3.01 HYDRAULIC JACKING SYSTEM

1. Has main jacks mounted in jacking frame located in tunneling shaft;
2. Positions jacks at the “haunches” or four corners of the RCB;
3. Has jacking frame which successively pushes string of connected pipes following tunnel excavation towards receiving shaft;
4. Has sufficient jacking capacity to push tunneling shield and string of box through the ground;
5. Has capacity at least 25% percent greater than calculated maximum jacking load;
6. Develops uniform distribution of jacking on end of box by use of a thrust transfer device and plywood cushions or “Kidney Ring”;

7. Use joint cushioning material, use ½ inch minimum thickness for pipe diameter 30 inches or less, use ¾ inch minimum thickness for pipe diameter greater than 30 inches. Use ¾ inch minimum thickness for all boxes.
8. Uses hydraulic jacks which are individually controlled;
9. Uses even pressure to all jacks during operation.

B Box Guides

1. Should be sufficient to support the section of the pipe or box;
2. Should direct the pipe or box on the proper line and grade.

C Tunnel Shield

1. Provides adequate protection for cutters and loaders at the face of the tunnel;
2. Conforms to the shape and size of the pipe or box;
3. May be a half or full shield.

D Ventilation

1. Provide adequate air flow for workers inside the tunnel excavation;
2. Provide equipment with the ability to maintain a reasonable air temperature inside the tunnel excavation.

E Other

1. Use other equipment as necessary to complete box jacking operations including, but not limited to, lighting, air compressor, and mud mixing system.

3.02 SHAFTS

A Shaft

1. Shall be constructed in accordance with the OSHA 1926 standard; Pits should be large enough to accommodate the backstop, jacking equipment, muck removal equipment, and maintain a minimal walking room on either side.
2. Install pipe or box so there is no interference with the operation of street highway, railroad or other facility and no embankment or structure is weakened or damaged.
3. Immediately after installation of pipe or box, backfill shafts or trenches excavated to facilitate jacking, boring or tunneling.

B Backstop

1. Should be constructed to withstand anticipated jacking loads; Constructed out of steel, concrete and/or other approved material.

3.03 JACKING

A Alignment

1. Place the entire jacking assembly in line with the direction and grade of the pipe or box;
2. Jack the pipe or box from the downstream end, whenever possible;
3. The final position of the box must not vary from the line and grade shown on the plans by more than one (1) inch in ten (10) feet;
4. Variation must be regular and in one direction;

5. The final flow must be in the direction shown on the plans.
- B Line and Grade Control
1. Use a construction laser to check line and grade after each time the pipe or box is pushed.
- C Excavation
1. Excavate the material at the face of the tunnel;
 2. Excavation should conform to the shape and size of the pipe or box;
 3. The excavation at the bottom of the box should maintain the desired grade of the tunnel;
 4. If desired, over excavate to provide not more than two (2) inches of clearance for the upper portion of the box;
 5. The distance the excavation extends beyond the end of the pipe or box or Tunnel shield must not exceed two (2) feet;
 6. Decrease the distance of the excavation as necessary to maintain stability of the material being excavated;
 7. Remove material through the pipe or box;
 8. Force the box into the excavated area with the jacking equipment.
- D Face Control
1. Provide adequate face control as necessary for the existing soil conditions.
- E Box Lubrication
1. Provide and maintain box lubrication system adequate to reduce friction between the pipe or box and the surrounding soil;
 2. Use high yield Wyoming bentonite;
 3. Lubricate the pipe or box a minimum of twice per work shift;
 4. Volume of mud pumped should be sufficient to fill over excavation.
- F Work Schedule
1. Maintain a standard work schedule as long as jacking loads allow;
 2. As jacking loads increase, increase work schedule;
 3. Use a 24 hour, 7 day week operation when necessary.
- G Grouting
1. Pressure grout any over excavation of more than one (1) inch.
- H Box Repair
1. Repair any box damaged in during jacking operations.
 2. Remove and replace any box damaged beyond repair at the Contractor's expense

3.04 CLEAN-UP AND RESTORATION

- A Perform clean-up and restoration in and around construction zone in accordance with Section 01140 – Contractor's Use of Premises.

- B In unpaved areas, grade surface as a uniform slope to pre construction conditions or better or natural grade as indicated on the Plans.

END OF SECTION