

SECTION 33 05 07.23

JACKING AND BORING

PART 1 GENERAL

1.1 SUMMARY

A. SCOPE:

1. Design, furnish and install the proposed piping alignment by jacking and boring construction methods, as shown on the drawings and conform to this specification. The work includes, but not limited to, survey, design, excavation, dewatering, removal of all materials encountered in the jacking and boring operations, disposal of all material not required in the work, grouting bulkheads, testing, cleaning, restoration, and incidentals as shown on the drawings and as specified herein.
2. The jacking and boring construction method shall consist of pushing (jacking) the casing pipe into the earth with a boring auger rotating with the casing/pipe to remove the spoil. The operations are to be completed while simultaneously providing ground stabilization techniques. The method shall include provisions for preventing uncontrolled inflow of loose or saturated soils.
 - a. Contractor is responsible for completing any additional geotechnical/subsurface investigations required to establish the appropriate parameters (i.e., limiting pressures, setback distances, depth of cover, etc.) for completing the design of the jacking and alignment, as specified herein.
 - b. Owner is responsible for obtaining the required general construction permits, easements and approvals, from the NCDOT or railroad agency. When encasement pipe is installed in the State right-of-ways the entire installation shall be as required by NCDOT. Where encasement pipe is installed in Railroad right-of-ways the entire installation shall be as required by the appropriate railroad agency. Where encasement pipe is installed across rivers, the entire installation shall be as required by USACE/NCDEQ. Where encasement pipe is installed in the City of Wilmington right-of-ways the contractor will pay and be responsible for obtaining the permits.
3. General:
 - a. Be responsible for the final design and constructed product, furnishing the design data, obtaining approval from agencies and for the safety of the operations and for personnel engaged in the work.
 - b. Be responsible for furnishing the qualified labor and superintendence necessary for this method of construction.
 - c. Furnish all items necessary to perform the jack and boring, and construct both the casing and carrier piping to the lines and grade shown on the drawings.
 - d. Installation of all jointing and gasketing materials, specials, flexible couplings, mechanical couplings, harnessed and flanged adapters, sleeves, tie rods, and all other Work required to complete the jack and bore, or tunneling installations.
 - e. Any modifications, damages or detrimental consequences to the existing ground conditions, structures, facilities, or utilities as a result of the Contractor's Work shall be repaired and restored to its original condition as directed by the Engineer at no additional cost to the owner.

4. Coordination:
 - a. Review installation procedures under other Sections and other contracts and coordinate with the Work that is related to this Section.
 - b. Be responsible for coordinating construction activities with the respective authorities.
5. Related Sections:
 - a. Section 32 92 01 – Seeding and Sodding.
 - b. Section 31 23 34 – Excavation, Trenching, Dewatering, and Backfilling.
 - c. Cape Fear Materials Specification Manual for the following materials:
 - 1) Ductile Iron Pipe.
 - 2) PVC C-900

1.2 COORDINATION

- A. Section 01 30 00 – Administrative Requirements: Requirements for coordination.
- B. Coordinate Work of this Section with the NCDOT, Cape Fear Public Utility Authority, City of Wilmington (COW), public agencies, and owners of public utilities or other facilities.

1.3 QUALITY ASSURANCE

- A. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
 1. American Railway Engineering Association: Specifications, Part 5; Pipeline - Crossings Under Tracks or Located on Railroad Property - For Flammable and Nonflammable Substances.
 2. Steel casing pipe conforming to ASTM A-139 and AWWA C200.
 3. Carrier piping, Ductile Iron Pressure Class 250, ANSI/ AWWA C151/A21.51, installation per ANSI/AWWA C600.
 4. Latest edition of ASTM D1248, ASTM D3350, ASTM F-714.
- B. All supervisory personnel must be adequately trained and will have at least ten years of experience in jack and boring operations. Contractor will have to submit the names and resumes of all supervisory field personnel prior to the start of construction.
- C. Materials and methods of construction used on railroad property shall be subject to the approval of the specific railroad company. Contractor to conduct work operations fully within the railroad company rules, regulations, and requirements.

1.4 SUBMITTALS

- A. Engineer will base the review of submitted details and data on the requirements of the completed work, safety of the work in regard to the public, potential for damage to public or private utilities and other existing structures and facilities, and the potential for unnecessary delay in the execution of the work. Such review shall not be construed to relieve the Contractor in any way of his responsibilities under the contract.
- B. Contractor shall not proceed with field activities until the required drawings and submittals are reviewed and accepted by the Engineer.

- C. Prepare and submit to the Engineer and Owner for review and approval no less than 20 days prior to starting the bore:
 - 1. Jacking and Boring Plan describing the equipment, methods, operational procedures, construction sequence, contingency plans, and other items of concern to be performed during the jacking and boring construction.
 - 2. Project Safety Plan.
 - 3. Submit site layout, equipment arrangement, and entry/exit pits drawings and technical specifications of the machine and equipment (including any modifications) proposed.
 - 4. Construction drawings, Specifications, and Contingency plans shall be submitted on the following items:
 - a. Complete details of the site clearing, excavation, drainage, security, and equipment mobilization including, but not limited to, the methods, procedures, and equipment arrangement to be used during the construction.
 - b. Complete details, drawings, and calculations signed and seal by an Engineer licensed in the state of North Carolina, of the significant factors and constraints associated with jacking and boring installations including, but not limited to, fluid pressures, jacking forces, pipe capacities, jacking and receiving pits shoring design, etc.
 - c. Provide plan and profile of the proposed jacking and boring alignments, indicating depth, angle of deflection, and radius of all pipe bends along the alignment.
 - d. Complete details of the grouting techniques/methods to be utilized for filling grout into the annulus between the adjacent soils and the outside of the casing piping, including but not limited to, fitting procedures, equipment, pumping procedures, fluid pressures, mixtures and plug systems. Also include methods of monitoring and controlling the grouting pressures.
 - e. Method of monitoring and controlling the specified line and grade of excavation including, but not limited to, the methods, procedures, reliability, and necessary ancillary equipment to be used during construction operations.
 - f. Complete details of the groundwater control, launching seals, muck/spoils containment, dewatering, drying, and removal including, but not limited to, the methods, procedures, equipment, contingency plans, and off-site disposal location.
 - g. Complete details of the casing and carrier piping capacities, maximum jacking loads, storage, assembly, and installation including, but not limited to, the methods, procedures, and equipment to be used.
- D. Quality Control Methods: At least 10 days prior to the start of the jacking and boring submit a description of his quality control methods he proposes to use during the operations to the Engineer. The submittal shall describe:
 - 1. Procedures for controlling and checking line and grade.
 - 2. Field forms for establishing and checking line and grade.
- E. Safety: Procedures including, but not limited to, monitoring for gases encountered shall be submitted.
- F. Hazardous chemical list as well as all MSDS and technical data sheets.

- G. Contractor must demonstrate expertise in "trenchless" methods by providing a list of five (5) utility references for which similar work has been performed in the last two years. The references should include a name and telephone number where contact can be made to verify the Contractor's capability. The Contractor must provide documentation showing successful completion of the projects used for reference. Conventional trenching experience will not be considered applicable.
- H. Have completed jacking and boring casing installations of same diameter or larger and have successfully completed lengths equal to the drawings or longer, crossings of railroads, and crossings of major state roads. Provide documentation in qualification submittal.
- I. Contractor is required to bring to the attention of the Engineer any known discrepancies with actual jacking and boring methods that the Contractor will be performing. This shall be stated, in writing, to Engineer no later than the pre-construction meeting.
- J. As-Built Drawings:
 - 1. Submit As-built documentation to Engineer and Owner within 7 days of the drill operation.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the site to ensure uninterrupted progress of the Work.
- B. Handle all pipe, fittings, specials, and accessories carefully with approved handling devices. Handling devices shall include ropes, fabric, or rubber-protected slings and straps. Chains, cables, or hooks inserted into the pipe ends shall NOT be used. Two slings spread apart shall be used for lifting each length of pipe. Do not drop or roll material off trucks.
- C. Store pipes and fittings on heavy wood blocking or platforms so they are not in contact with the ground. Pipe supports shall be spaced suitably and of such widths as not to allow deformation of the pipe at the point of contact with the supports.
- D. Stacking of pipe shall be limited to a height that will not cause deformation of the bottom pipes under anticipated temperature conditions.
- E. All ends of stored piping shall be securely capped/plugged to prevent entry of soil, debris, and vermin.

PART 2 PRODUCTS

2.1 JACK AND BORING SYSTEM, GENERAL:

- A. The jack and boring system shall consist of, but not limited to, the following components:
 - 1. Jacking system suitable for forcing the casing through the embankment.
 - 2. Auger Boring and Spoil removal system.

3. Pipe lubrication system.
- B. Jacking and Boring over-cut shall not exceed ½-inch on the outside radius of the casing pipe being installed.
 - C. The excavation equipment and system shall be fully capable of excavating and removing all material that will be encountered during the construction operations.
 - D. The automated spoil transportation system shall match the excavation rate to the rate of spoil removal, maintaining settlement or heave within tolerances specified herein.
 1. If a slurry spoil transportation system is used, the groundwater pressure may be managed by use of the slurry pumps (which may be variable speed), pressure control valves and a flow meter. A slurry bypass unit shall be included in the system to allow the direction of flow to be changed and isolated, as needed. A solids separation process shall be provided when using slurry transportation systems. The process shall be designed to provide adequate separation of the spoil from the slurry so that the clean slurry can be returned to the cutting head for reuse.
 2. If an Auger spoil transportation system is utilized, the groundwater pressures may be managed by controlling the volume of spoil removal with respect to the advance rate (Earth Pressure Balance Method) and the application of compressed air. In soils with excessive groundwater, approval of the Engineer shall be required for the earth pressure balance auger systems. Approval shall be based on the evaluation of the equipment's ability to balance soil and groundwater pressures at the face, stability of the soils and the significance of the groundwater present.
 3. Contractor to identify and submit for approval the type of separation system to be used.
 - E. Pipe Jacking Equipment:
 1. The main jacks shall be mounted in a jacking frame and located in the drive (starting) shaft. The jacking frame successively pushes the steel casing pipes toward a receiving shaft. The jacking capacity shall be sufficient to push the auger/boring machine and/or length of casing piping through the ground.
 2. The main jacking equipment installed shall have a capacity greater than the anticipated jacking load. The hydraulic cylinder extension rate shall be synchronized with the excavation rate of the boring, which shall be determined by the specific soils conditions.
 3. Provide intermediate jacking stations when the total anticipated jacking force needed to complete the installation exceeds the designed maximum jacking force of the pipe.
 - F. Pipe Lubrication System:
 1. A pipe lubrication system may be utilized when anticipated jacking forces on the pipe are expected to exceed the capacity of the main jacks or exceed the pipe design strength with the appropriate safety factor. A prior approved lubricant shall be injected at the rear of the auger, or boring machine and, if necessary, through the casing pipe walls to lower the friction developed on the surface of the pipe during jacking and thereby reduce the jacking forces.

2.2 MATERIALS

- A. Refer to the CFPUA Materials Specification Manual for a list of applicable materials including:
1. Piping used for the conveyance of water, wastewater, and non-potable water.
 2. Casing Pipe
 - a. Use only new, welded, or seamless steel pipe per ASTM A-139, Grade B. Casing minimum thickness to be 0.625-inches, or as required by the site-specific regulatory agencies or property owner. The casing wall thickness shall be designed to accommodate the maximum jacking load allowed, as well as the expected earth and live loads. Be fully responsible for the sufficiency of the casing thickness provided.
 - b. Joints in steel casing pipe shall be butt-welded joints, conforming to the requirements of AWWA C206. Pipe 36 inches in diameter and larger shall be welded both inside and outside of the pipe/casing.
 - c. After welding, the joint and the surrounding damaged or uncoated area shall be coated with the same material and to the same thickness as the shop applied coating.
 - d. All steel casing pipe and welds shall meet or exceed either the site-specific regulatory agency's requirement, or the manufacturer's minimum wall thickness to meet or exceed the greater of either: installation (jacking), loading, or carrier load requirements.
 - e. The size (diameter) of the steel casing shall be in accordance with the table below. Larger encasement pipe sizes may be substituted upon per-approval or as directed by the Engineer or Owner.

Carrier Pipe OD	Encasement Pipe OD	Roadway Encasement Thickness	Encasement Pipe ID	Railroad Encasement Thickness	Encasement Pipe ID
6", 8", 10"	16"	0.250"	15.5"	0.281"	15.438"
12", 14", 16"	24"	0.250"	23.5"	0.375"	23.25"
18", 20"	30"	0.312"	29.376"	0.469"	29.062"
24"	36"	0.375"	35.25"	0.531"	34.938"
30"	42"	0.500"	41"	0.625"	40.75"
36"	48"	0.500"	47"	0.688"	46.624"

Exceptions to encasement pipe requirements shall be as shown on the drawings.

- f. All steel pipes shall be designed for the external and internal loads to which they will be subjected. Steel casing shall meet ASTM specifications and be designed to meet or exceed a minimum live load of a Cooper E-80 loading. The loading consists of 80 kip (356 kN) axle loads spaced 5-feet (1.5 m) on centers.
- g. K - Casing Insulators / Stainless Steel
- h. Casing End Seals:
 - 1) Seal each end of casing pipe with brick and Type @ Mortar.

PART 3 EXECUTION

3.1 INSTALLATION

A. General:

1. Comply with the lawful requirements of the North Carolina Department of Transportation, Cape Fear Public Utility Authority, public agencies, and owners of public utilities or other facilities respecting the safeguarding of structures and improvements that might be endangered by the jacking and boring, or micro tunneling construction operations.
2. Install the required steel casing by means of jacking and boring, specified herein, and as recommended by the pipe manufacturer.
3. The jacking and boring, along with the installation of the casing pipe shall be done simultaneously and continuously until the casing pipe is in final position.
4. Be responsible for his means and methods of jacking and boring, and shall ensure the safety of the work, the Contractor's employees, the public, and adjacent property, whether public or private.
5. Maintain traffic flow at all times during the progress of the work. Provide adequate signs, barricades, flag persons, lights, and other control devices in accordance with the provisions and requirements of the North Carolina Department of Transportation or City of Wilmington standards. No lanes of traffic shall be closed without prior approval.
6. Contractor to provide erosion and sediment control to minimize erosion and the transport of sediment beyond the limits of the work area.
7. Anticipate that portions of the jacking and boring will be below the groundwater table and dewatering will be required.
8. Comply with all local, state, and federal laws, rules, and regulations at all times to prevent pollution of the air, ground, and water.
9. Locate, mark, and protect existing utilities and facilities in the work area. Perform test pits as required.
10. If there is a conflict between manufacturer's recommendations and the Drawings or Specifications, request instructions from Engineer in writing, before proceeding.

B. Jacking and Boring Operations:

1. Provide and maintain adequate boring equipment and install support systems as required.
2. The boring operations shall be progressed on a 24-hour basis without stoppage (except for adding lengths of pipe) until the leading edge of the casing pipe has reached the receiving pit, unless identified otherwise by state agency's permit.
3. The boring operations shall consist of excavating the embankment material ahead of the casing, remove excavated material through the pipe and force the pipe through the embankment with jacks into the spaced provided. No jetting, sluicing, or wet boring is permitted.
4. All surfaces shall be smooth and uniform without bulges, dents, or warping of lengths, and only new pipe shall be used.
5. Finished lengths of pipe shall be furnished with beveled cut ends to facilitate proper welding of transverse joints. The diameter and wall thickness of the pipe shown on the drawings is the minimum required and no extra compensation shall be claimed by the Contractor if a larger and thicker pipe is used. Contractor is responsible in the event that the casing does buckle or collapse during these operations.

6. The over-cut by the cutting head shall not exceed the outside diameter of the casing pipe by more than ½-inch.
7. Required launching and receiving pits/shafts shall be excavated and maintained to the minimum dimensions necessary to perform the operations and allow for safe working practices.
8. The pits or shafts shall be adequately barricaded, sheeted, braced, dewatered, and ventilated as required, in accordance with applicable specifications and regulations.
9. Contractor to use thrust blocks designed to distribute loads in a uniform manner so that any deflection of the thrust block is uniform and does not impart excessive load on the shaft itself or cause the jacking frame to become misaligned.
10. Position jacks so that the resultant force is applied along the centerline of the casing pipe, and force is applied evenly to the entire end of the pipe.
11. Backstops shall be provided for adequately distributing the jack thrust without causing deformation of the soil or other damage.
12. Contractor to monitor and control the jacking pressure/force applied to ensure that pipe manufacturer's recommended limits are not exceeded.
13. Contractor responsible for all testing, survey, and documentation of the pre/post construction site conditions, in which to provide as a basis of comparison for the post construction conditions to be evaluated.
14. Once jacking has begun, the operation must continue without interruption, insofar as practical, to prevent the pipe from becoming firmly set in the embankment.

C. Steel Casing Installation

1. The installation of the casing shall be in accordance with manufacturer's recommendations and subject to the approval of the agency having jurisdiction.
2. The casing pipe shall be adequately protected to prevent crushing or other damage under the jacking pressures. Provide timbers for cushioning between the pipe pushed end and the jacking equipment.
3. The casing installation shall not produce upheaval, settlement, cracking, movement of the road.
4. Install casing piping concurrent with the bore, as earth is removed.
5. Surplus and unsuitable excavated material shall be disposed of by the Contractor.

D. Carrier Pipe Installation

1. All joints of the carrier piping within the casing shall be restrained.
2. Clean all dirt and debris from the casing piping.
3. Attach the centered/restrained casing spacers/guides to the carrier pipe sections, as required to prevent excessive sag, bending, shear stress and to support the pipe barrel in accordance with pipe manufacturer's recommendations. Piping is NOT to be supported by bells/joints.
4. A spacer shall be placed such that it supports the carrier pipe within 2 feet of the casing ends and a minimum of three spacers per 20-foot pipe section. For pipe sections, longer or shorter than 20 feet, follow the manufacturer's instructions and recommendations.
5. Lubricant for pipe guides shall be drilling mud or flax soap. Petroleum, or Oil based products are NOT allowed.
6. Protect and preserve the interior surfaces of the steel casing from damage.
7. Contractor to provide brick casing end seals.
8. K - Tracer wire shall be continued through casing.

- E. Transitions from One Type of Pipe to Another:
 - 1. Provide all necessary adapters, specials and connection pieces required when connecting different types and sizes of pipe or connecting pipe made by different manufacturers.

END OF SECTION