

1.1 SUMMARY

- A. The work includes furnishing and installing cased tunnels by pipe ramming methods where indicated to pass other utilities or obstructions without open excavation, and installation of specified appurtenances as shown on the drawings and as specified in these Special Provisions.
- B. For the purpose of this Section, pipe ramming is defined as the trenchless installation of a pipe by pushing the pipe using a pneumatically powered driving device. During the ramming process the pipe may be unloaded using a screw auger, screw conveyor system or other methods.
- C. Set-up of pipe ramming machine of suitable capacity to drive home entire length of casing.
- D. The Contractor shall have the option to select the necessary steps for casing pipe installation, subject to approval by the CONSTRUCTION MANAGER.

1.2 DEFINITIONS

- A. Pipe Ramming: A non-steerable system of forming a bore by driving an open-ended casing using a percussive hammer from a pit and only displacing the wall thickness of the casing. The soil will remain in the casing until the bore has been completed and then may be removed by water, auguring, jet-cutting or compressed air.
- B. Drive/Launch Pit: A pit used for "launching" a trenchless technology excavation tool.
- C. Launch Seal: A mechanical seal, usually comprised of a rubber flange that is mounted to the wall of the drive pit. The flange seal is distended by the pipe as it passes through creating a seal to prevent groundwater or lubrication inflow into the pit during ramming operations.
- D. Locator: An electronic instrument used to determine the position of the leading edge of the pipe. Sometimes referred to as a walkover system or water level.
- E. Reception/Exit Shaft/Pit: Excavation into which trenchless technology equipment is driven and recovered following the installation of the product pipe.
- F. Reinstatement: The backfilling, compaction and resurfacing of any excavation in order to restore the surface and underlying structure to enable it to perform its original function.
- G. Retrieval Seal: A mechanical seal usually comprised of a rubber flange that is distended by the pipe. Similar to the launch seal but used during the holing-out operation. Serves to keep water from infiltrating into the reception pit.
- H. Sliplining: Insertion of new pipe by pushing it into the existing pipe.

1.3 SUBMITTALS

- A. Submit for approval complete working drawings showing details of the proposed method of construction and the sequence of operations to be performed during construction. Show the method of pipe ramming, including the ramming system to be used, location of working pits including method of excavation, shoring and bracing appurtenance installation, and dewatering techniques that are proposed to be used. These submittals shall include all the restrictions and limitations imposed by the special provisions. The following is not intended to limit, but to provide, the minimum of detail, which must be included.

1. A detailed description of the pipe ramming procedure including construction techniques to provide the access required, to install pipe, in conformance with contract documents.

2. Manufacturer's literature describing in detail the pipe ramming system to be used. Detailed description of projects on which this system has been successfully used including the names, addresses and telephone numbers of owner's representatives for these projects as well as length, diameter, and pipe material used.
3. Calculations and drawings indicating limits of access pits and any ground support to be utilized.
4. Methods of spoils disposal.
5. A groundwater stabilization scheme covering the excavations for starter and receiver pits. Verify this plan to stabilize anticipated unstable soil conditions. Such verifications shall include all calculations and detail drawings for methods of controlling groundwater.
6. Certification by the pipe ramming manufacturer of the thrust, condition, and operational characteristics of all equipment to be used for installing the specified pipes. The equipment shall employ a spoil removal system. The system shall include a safeguard to prevent caving beyond the outside diameters of the pipe.
7. Working Drawings, including the following pages:
 - a. Layout of pipe ramming and ancillary equipment at each pit location.
 - b. Shop drawings including configuration of cutter head shoe and overcut.
 - c. Spoil removal system details.
 - d. Pipe lubrication system details.
 - e. Grade and alignment control system details.
 - f. Groundwater control provisions.
8. Details of mucking system and soil disposal methods.
9. Calculations demonstrating that the pipe selected has been designed to support the maximum anticipated earth loads and superimposed live loads, both static and dynamic, which may be imposed on the pipe. Determine the additional stresses imposed on the pipe during ramming operations and upgrade the quality and strength of the pipe and pipe joints to extent necessary to withstand the additional stresses imposed by the ramming operation. The details shall be submitted for approval.
10. Complete information on Contractor's safety plan for personnel conducting the ramming operations and appurtenance installation. The plan shall include provisions for lighting and electrical safeguards.
11. Keep and maintain at the construction site a complete set of field drawings for recording as built conditions. It shall have marked or noted there on all field information, properly dated, recording as built conditions. This set of drawings shall be kept up to date.
12. Pipe certification of compliance.
13. Pipe jointing method and details.
14. All contractor submittals requiring structural design shall be signed by a professional civil or structural engineer registered in the State of _____ . (Project Location)
15. Written documentation summarizing the qualifications of the project, superintendent, operators, and site safety representative.

- B. Submit a log of the ramming operations. As a minimum the log shall consist of the following:
 - 1. The position of the pipe in relation to the design line and grade.
 - 2. The date, the starting time, and the finish time.
 - 3. Inclination.
 - 4. Advance rates.
 - 5. Hammer strokes per minute.
 - 6. Operating pressure
 - 7. Muck quantities removed.
- C. Submit a separate hand log tracking pipe lubricant used in gallons, its viscosity, and pumping pressure. Log shall be submitted daily.
- D. The CONSTRUCTION MANAGER will base the review of submitted details and data with consideration of requirements for the completed work, utilities, and the possibility of unnecessary details in the execution of the work to be constructed under this contract.
- E. Equipment and installation methods shall be adequate to preserve quality of pipe.

1.4 QUALITY ASSURANCE

- A. The project superintendent shall have at least three years of pipe ramming experience and shall have worked on at least two projects in similar ground conditions using equipment similar to the equipment required for this project. The operator shall have at least two years of pipe ramming experience and shall have worked on at least one pipe ramming project using the same equipment required for this project.

1.5 PROJECT CONDITIONS

- A. Work is to be completed in accordance with the special provisions.
- B. If person entry is required, provide adequate ventilation. Design ventilating system to include such factors as the volume required to furnish fresh air and the volume to remove dust and vapor. All entry into the casing shall be conducted under the latest "Confined Space Entry" regulations
- C. Provide adequate lighting for the nature of the activity being conducted by workers. Separate both power and lighting circuits and thoroughly insulate. Lighting voltage not to exceed 120 VAC protected by a ground fault circuit interrupter.

1.6 CONTRACTOR QUALITY CONTROL

A. FIELD TESTS AND INSPECTIONS

- 1. The Construction Manager will witness field tests specified in this section.
- 2. Perform field tests and provide labor, equipment, and incidentals required for testing. Be able to produce evidence, when required, that each item of work has been constructed properly in accordance with the drawings and specifications.

B. CASING TESTING

1. General: Check each straight run of casing pipe for gross deficiencies by holding a light in the casing; it shall show a practically full circle of light through the casing when viewed from the adjoining end of line.
2. Make sure that the pipe is unloaded from trucks with crane or backhoe and not dropped off or pushed off.

C. QUALITY CONTROL

1. Contractor shall establish and maintain quality control for operations under this section to assure compliance with contract requirements and maintain records of his quality control for materials, equipment, and construction operations including but not limited to the following:
 - a. Preparatory Inspection: (To be conducted prior to commencing work.)
 1. *Check pipe for conformance to approved certified tests.*
 - 1b. *Check to make sure that there is no mid seam welds or if there are they shall be certified to be 100% penetration weld.*
 2. *Check pipe for proper storage and handling.*
 3. *Discuss and review pipe installation procedure with Construction Manager to include placing of pipe, joint preparation and application of each pipe used.*
 - b. Initial Inspection: (To be conducted after a representative sample of the work is complete.)
 1. *Check for proper depth and grade for pipe.*
 2. *Check method of joining pipes.*
 3. *Check the pipe for proper alignment.*

PART 2 - EQUIPMENT AND MATERIALS**2.1 PNEUMATIC PIPE PUSHER**

- A. Pneumatic pipe pusher/driving device selected shall be a mono-bloc design with rear cushion and Teflon slide seals, no bolts or threaded connections; specifically designed for installing pipe from a drive pit through the geological materials as described in the Geotechnical Report.
- B. Patented soil removal system (soil port - partial removal with cone or adaptor) shall be capable of being operated in a manner which will prevent loss of ground during installation.
- C. Amount of overcut shall be compatible with the soil conditions, stiffness characteristics of selected pipe, and joint system at the designed maximum ramming loads.
- D. Line and grade shall include, as a minimum, the capability to report the operating parameters listed in Article 1.3B.

2.2 MATERIALS

- A. Pipe material shall be steel.
- B. Pipe to be placed by ramming shall be as follows:
 1. Steel casing shall be new, smooth wall carbon steel pipe which conforms to ASTM Specifications A139, Grade B. No hydrostatic testing will be performed.
 2. Steel casing pipe shall have a minimum yield strength of 35,000 psi.

3. Pipe casing diameter shall be XX-inch I.D. minimum. Pipe wall thickness shall be determined by contractor based on static and dynamic loads from traffic loading and anticipated ramming forces for selected pipe and driven pipe lengths. Pipe lengths shall be determined by contractor.
4. Steel pipe joints shall be (1) a pressure fit type, or (2) welded.
5. All steel casing pipe shall be square cut. (with beveled ends for welding)
6. Steel casing pipe shall have a roundness such that the difference between the major and minor outside diameters shall not exceed 1% of the specified nominal outside diameter or 0.25 inch, whichever is less.
7. Steel casing shall have an outside circumference which is within 1% of the nominal circumference which in within 0.50 inch, whichever is less.
8. Steel casing pipe shall have a minimum allowable straightness deviation in any 10 foot length of 1/8 inch.

PART 3 EXECUTION

3.1 CONSTRUCTION

A. PITS

1. Construction techniques required to provide access for pipe ramming shall be such as to ensure the safety of the work. Acceptable excavation methods include the use of interlocked steel sheet piling or open excavation.
2. Final dimensions of access pits selected by Contractor shall conform as a minimum with dimensions required to permit installation of the work.
3. The contractor shall be required to properly support all excavations and to prevent all movement of the soil, pavement, utilities or structures outside of the excavation. All pits shall conform with applicable Local Safety Standards, OSHA Standards, trenching and shoring standards.
4. If at any time the method be used by the contractor for supporting any material or structure adjacent to any excavation is not safe in the opinion of the Construction Manager or applicable Federal, State or local inspection authorities, the Construction Manager may require and the Contractor shall provide additional bracing and support necessary to furnish the added degree of safety required by the Construction Manager. The contractor shall provide such added bracing and support by such method approved by the Construction manager as he may elect to use but the taking of such added precautions shall in no way relieve the contractor of his sole final responsibility for the safety of lives, work and structures. The use of such additional bracing and support shall be without additional cost to the authority. The absence of an order from the Construction Manager for the aforementioned additional bracing shall in no way relieve the contractor of his sole and final responsibility.
5. Construct pits to accommodate the installation of pipe casings and ramming device. Install seals in the pit walls as required to control ground movement where the casings enter and exit the ground.
6. All work of excavating shoring and bracing, and pipe ramming shall be so executed that settlement is minimized, the in-place casing shall have full bearing against earth, and no voids or pockets are left in any portion of the work.
7. Before beginning construction at any location of this project, adequately protect existing structures and other permanent objects. The repair of or compensation for damage to permanent facilities due to negligence or lack of adequate protection on the part of the contractor will be at no cost to the Authority.
8. Provide surface drainage during the period of construction to protect the work.

9. Conduct operations in such a fashion that trucks and other vehicles do not create a dirt nuisance on the taxiway, runway or impact airport operations. Secure the required permits and promptly remove and dispose of any spillage.

10. Blasting will not be permitted.

11. Provide all dewatering and test any groundwater discharges. All discharge limits and reporting requirements shall be the responsibility of the contractor.

12. Traffic: Size and locate pits and their work areas so as to avoid interferences with all forms of traffic.

B. Control of Line and Grade

1. The Construction manager will establish the baseline and benchmarks indicated on the plans. Check these baselines and benchmarks at the beginning of the contract period and report any error or discrepancies to the Construction Manager.

2. Use these baselines and benchmarks to furnish and maintain all reference lines and grades for the pipe installation. Use these lines and grades to establish the exact starting location of the pipe.

3. Submit to the Construction Manager copies of field notes used to establish all lines and grades; however, the contractor remains fully responsible for the accuracy of his work and the correction of it, as requires.

4. The excavation and run of pipe rammed shall be controlled such that the deviation from grade is below the design grade.

5. After installation of the pipe, provide the Construction Manager with access to both casing ends for visual inspection of the line and grade of the completed casing.

3.2 INSTALLATION

A PIPE RAMMING:

1. No work shall commence on the pipe ramming phase until the design and construction procedure has been approved in writing by the Construction Manager. The contractor is totally responsible for the performance of the equipment and methods selected for this phase. The Construction Manager's approval signifies only that the construction process is compatible with the overall objectives of the project.

2. Each pipe section shall be rammed forward as the excavation progresses in such a way to provide complete and adequate ground support at all times. Lubrication shall be applied to the external surface of the pipe to reduce skin friction. A hammer frame shall be positioned to develop a uniform distribution of ramming forces around the periphery of the pipe. Special care shall be taken by the contractor to insure that the launch seal is properly designed and constructed. Special care should be taken when setting the pipe guard rails in the pit to ensure correctness of the alignment.

3. Be responsible for monitoring ground movements associated with the work and making suitable changes in the construction methods to control ground movements and prevent damage or detrimental movement to the work and adjacent structures and pavements. Permissible tolerances with respect to settlement of ground surface and alignment of pipe shall not be exceeded.

4. The soil transportation method shall be capable of handling and removing material identified in the geotechnical report. All excavated material from the pipe ramming and pit construction shall be disposed of off-site by the contractor.

5. A lubrication system shall be provided that injects an approved lubricant on the inside and outside of the pipe to lower the friction developed on the sides of the pipe during ramming. Spacing of lubricant points shall be at the contractors option with approval from the Construction Manager.

6. The overcut on the pipe shall not exceed 1 inch without the approval of the Construction Manager. The annular space created by the overcut shall be filled with a lubricant that has been proved suitable for the particular soil conditions.

3.3 INVERT FINISHING

Clean pipe of all debris from construction.

3.4 SAFETY WORK PRACTICES

All construction practices shall comply with the "Safety and Health Regulations for Construction" of the U.S. Department of Labor "Occupational Health and Safety Act."

Addendum to Ramming Specifications

On more difficult projects (Grade Bores), some or all of the following may also be included in the Pipe Ramming Specifications or Certification Section in the job specifications.

1. The pipe ramming contractor must have successfully completed five (5) pipe ramming projects, or installed over 2000 feet of steel casing in grade bore/difficult soil situations within North America in the last four (4) years using pipe ramming equipment and materials of the type that meet the minimum requirements of the job specification.
2. At least one of the projects must have been completed within one (1) year prior to the date of this job. In addition, at least one (1) project must have been in the area with the geological and surface conditions similar to those described for this project.

A. Submit a complete description of projects which actual work was performed by the Contractor. This list is to include project locations, date of projects, owner, owner's construction representative, owner's construction representative's current telephone number, type of equipment utilized, type and size of casing pipe used in pipe ramming operations, contract or subcontract amount, description of all litigation and/ or unresolved claims in connection with these projects, and any other information relevant to the issue of the successful completion of such projects. Include projects where the pipe ramming contractor was a prime contractor or a subcontractor. If the pipe ramming contractor has not completed any such project(s) other than those which are in progress on the date of this application, the pipe ramming contractor must demonstrate to the satisfaction of the parties involved that the cause of the lack of completion is unrelated to criteria determining pre-qualification for this project.

B. The project superintendent(s) and pipe ramming machine operator(s) are required to have at least three (3) years experience and two (2) years of pipe ramming experience respectively, using the similar type of equipment required for this project. Submit the names, resume, and experience summary of at least three (3) project superintendents and three (3) pipe ramming machine operators who will be available for this assignment. Two (2) of the proposed project superintendents and two (2) of the proposed machine operators must be assigned to this project.

C. The pipe ramming contractor must clearly demonstrate that the methods and materials used in his operations have a proven track record for at least four (4) years. The Contractor must supply third party test results meeting ASTM Standards of the casing pipe material used by the Contractor. This is to include test results of the weld for the casing pipe. A list of projects, description of such projects, location, dates of projects, owner, owner's construction representative's current telephone number, type and size of casing pipe material and methods of installation, contract or subcontract amount, description of all litigation and/or unresolved claims in connection with these projects and any other information relevant to the issue of the successful completion of such project.