SPECIAL PROVISIONS
FOR
AUGER BORING

Black Hawk County
NHSX-063-6(96)--3H-07

Effective Date
March 17, 2017

THE STANDARD SPECIFICATIONS, SERIES 2015, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE SPECIAL PROVISIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

150242.01 DESCRIPTION.

A. This section covers installation of a 16-inch nominal size conveyance pipe tunneled by a jacked casing pipe with auger boring method through the improved ground. The casing shall consist of a steel pipe with a minimum outside diameter (O.D.) of 36 inches.

B. The work also includes design of thrust block and casing, equipment, material, installation, and grouting required to monitor the auger boring operation as required herein.

C. The Contractor shall not utilize any other tunneling method without written permission from the Engineer.

D. There are multiple construction activities in the adjacent area. The Contractor shall coordinate with other construction activities, such as temporary shoofly embankment, Canadian National Railway bridge demolition, temporary dewatering system, temporary shoring, and groundwater suppression system.

E. Design Criteria.

1. The casing and thrust block shall be designed by the Contractor and shall be signed and sealed by a Professional Engineer licensed in the State of Iowa.

2. Design the steel casing to withstand full overburden pressure, potential hydrostatic pressures, applicable highway and railroad loads, possible construction surcharge loads, and jacking forces. Maximum jacking forces shall not exceed 67% of the ultimate pipe jacking capacity at all pipe locations or 67% of the ultimate jacking/thrust block system capacity, or 67% of the maximum design strength of the jacking pipe as established by the manufacturer, whichever is lowest. The railroad loading shall be E-80.

3. A thrust block shall be used to transfer jacking loads to the soil behind the launching pit. The thrust block face shall be constructed perpendicular to the proposed jacking pipe alignment.

The thrust block shall be designed to withstand the maximum jacking forces developed by the main jacks with deflection or displacement not exceeding 1 inch. Forces applied to the soil shall not exceed the passive earth pressure with a minimum factor of safety of 2.0.

F. Qualification: Meet the qualification requirements described in this section in order to perform the work.

1. All auger boring work shall be performed by an experienced Contractor who has at least 5 years of experience in performing auger boring work and has completed at least three similar projects involving at least a 150-foot auger boring tunnel in sand. The project superintendent shall have at least 5 years of experience supervising auger boring operations. The auger boring machine operator(s) shall have technical training in the operation of the proposed auger boring equipment and shall have completed, as a primary operator, at least three similar auger boring projects involving at least a 150-foot auger boring tunnel on each project. The Site Safety Representative and personnel responsible for air quality monitoring shall be experienced in tunnel construction and shall have current certification by OSHA.

2. The Contractor's surveyor responsible for line-and-grade control shall be a licensed surveyor licensed in the State of Iowa who has prior experience in similar underground projects.

150242.02 MATERIALS.

A. Steel Casing Pipe.

1. Use only new, steel pipe meeting the requirements of ASTM A 139, Grade B; ASTM A 252, Grade 2; or ASTM A 53, Grade B. Pipe may be welded or seamless. The minimum wall thickness shall be 0.5 inch.

2. Welds shall comply with American Welding Society Code D1.1. Weld all joints with full penetrating weld. Welders shall be qualified according to Materials I.M. 560. Welds shall comply with Materials I.M. 558.

3. Upon approval of the Engineer, an interlocking casing pipe connection system may be used in lieu of field welding the sections of casing pipe.

B. Carrier Pipe.

Carrier pipe shall comply with conveyance pipe requirements described in Special Provisions for Groundwater Suppression System.

C. Casing Spacer.

1. Use manufactured casing spacers to position carrier pipe in casing. Do not use wood skids.

2. Casing spacers shall meet the following material requirements:
- **a.** HDPE Band/Panel and Riser: ASTM D 638.
- **b.** Stainless Steel or Carbon Steel Band/Panel and Riser: Type 304 stainless steel according to ASTM A 240 or carbon steel according to ASTM A 36.
  - **1)** Liner: Elastomeric PVC per ASTM D 149.
  - **2)** Spacer Skid/Runner: Abrasion resistant polymer with a low coefficient of friction.
  - **3)** Fasteners: Type 304 (18-8) stainless steel per ASTM A 193.

D. Lubricant.

1. Bentonite: Shall be high swelling montmorillonite clay or other product approved by the Engineer. Neat bentonite without additives shall be high quality sodium bentonite or approved equal.

2. Polymers: Polymers used as pipe lubricant or additive to bentonite shall be nontoxic.

3. The use of additives shall require the approval of the Engineer.

4. Oil-based lubricant shall be prohibited.

5. Lubrication shall meet all federal and local environmental requirements.

E. Backfill Grouting.

Backfill grouting material shall be one of the following:

- Flowable mortar according to Article 2506.02 of the Standard Specifications.
- Controlled Low Strength Material (CLSM) according to Article 2552.02, G,3 of the Standard Specifications.

F. Auger Boring Equipment.

1. Auger boring equipment selected for the project shall be suitable for and capable of efficiently advancing through the geologic conditions described in the plans. The selected auger boring equipment shall be capable of mining through materials with an unconfined compressive strength of 200 pounds per square inch.

2. The cutting head shall be changeable and retrievable from the launching pit.

3. The maximum radial over cut shall be 0.5 inch. The maximum allowable radial overcut value has been selected to minimize potential settlements of the adjacent facilities.

150242.03 CONSTRUCTION.

A. Submittals.

1. Thrust block design and other engineered components shall be signed and sealed by a Professional Engineer licensed in the State of Iowa.

2. Qualifications: The Contractor shall submit the resume of the personnel and the Contractor that will perform the auger boring work and submit qualifications for the Contractor and Contractor's personnel that meet the requirements of Section 1.F, "Qualification". In addition, the Contractor shall submit names and training/qualifications of personnel that will perform air quality monitoring and qualifications of the Site Safety Representative.

3. Auger Boring Operations.

a. The Contractor shall submit a Work Plan with complete Contractor's construction drawings and written description identifying details of the proposed method of construction and sequence of operations to be performed during construction. The drawings and descriptions shall be sufficiently detailed to demonstrate to the Engineer whether the proposed materials and procedures will meet the requirements of this Special Provision. The Work Plan, including drawings, shall at a minimum include the following items:

1) Arrangement drawings and technical specifications of the auger boring machine, experience record with this type of machine, and experience and training records of the equipment operator. Include the following information concerning the auger boring machine: dimensions, cutting head style, cutting head position relative to casing, casing and band diameters, torque, speed and thrust, and auger and muck casing diameters.

2) The method of maintaining and controlling line and grade of auger boring operation.

3) The method and details of spoil removal, including equipment type and numbers, processing, and disposal.

4) A description of the lubrication system and material of lubricant.
5) A description of the ventilation system to be used.
6) Details of the auger boring method and operation.
7) Plans for storage and handling of casing.

b. Launching/Receiving Pits: comply with Special Provision for Temporary Shoring.

4. Details of casing spacers and manufacturer's specifications.

5. Safety Plan: A Safety Plan for the auger boring operations including air monitoring equipment and procedures, and provisions for lighting, ventilation, and electrical system safeguards. The plan shall also include at a minimum:
a. The method for protection against soil instability and groundwater inflow.
b. A description of the safety for tunnel and launching/receiving pit access and exit including ladders, stairs, walkways, and hoists.
c. The method of protection against mechanical and hydraulic equipment operations, and for lifting and hoisting equipment and material.
d. The method of monitoring for hazardous gases.
e. A description of the means for emergency evacuation and self-rescue.

6. Calculations: Calculations shall be submitted in a neat, legible format. Assumptions used in calculations shall be consistent with information provided in this Special Provision.
a. Design calculations shall demonstrate that the proposed jacking pipe is capable of supporting the maximum stresses to be imposed during jacking. The calculations shall take into account earth and hydrostatic loads, jacking forces, external loads such as live loads due to traffic and railroad, and any other loads that may be reasonably anticipated during jacking. All loads shall be shown and described. Include assumed maximum drive length.
b. Calculations shall demonstrate that the soil behind the thrust block can transfer the maximum planned jacking forces exerted by the jacks to the ground during pipe installation without excessive deflection or displacement.
c. Calculations of the thrust block design shall be included.

7. Grouting Work Plan: The work plan for placing backfill grout shall include sequence of work, type(s) of equipment, location of equipment, placing procedures, (i.e. batching, mixing, and pumping location and procedures), pump line arrangement (including moving and breaking), maximum pipe length to be backfilled and end bulkhead details, communications provisions, methods for monitoring mix, testing procedures, and cleanup procedures. The work plan shall include pumping pressures, pumping rates, volumes to be placed per day, injection locations, maximum grout age before set initiation, maximum injection pressures and sequence of placement and pumping.

8. Daily Records: The following daily records shall be submitted to the Engineer by noon on the day following the shift for which the data or records were taken:
a. Jacking Records: The Contractor shall provide complete jacking records to the Engineer. These records shall include at a minimum: date, time, name of operator, tunnel crossing identification, installed pipe number and corresponding tunnel length, rate of advance, jacking forces, spoil feed rates, line and grade offsets, and durations and reasons for delays. Manually recorded observations shall be made at intervals of not less than once per 4 feet, as conditions change, or as directed by the Engineer.
b. Survey Measurements: Survey measurements of casing alignment.
c. Grouting Records: The Contractor shall submit daily reports and records of backfill grout placement that at a minimum include the following items:
1) A delivery ticket of the backfill grout.
2) A printout of the actual scale weight for all loads batched.
3) Volumes and backfill levels placed.
4) Stationing of backfill grout placement.

5) Injection locations and pressures.
6) Times of grout placement.

9. Contingency Plans: The following list includes problem scenarios that may be encountered during the auger boring operations. The Contractor shall submit contingency plans for dealing with each problem scenario while satisfying the specifications. These plans shall include the observations and measurements required to clearly identify the cause of the problems.
a. Possible obstructions and obstruction removal
b. Loss of line or grade
c. Unstable ground
d. Surface settlement exceeding threshold limits
e. Excessive groundwater inflows

B. General.

1. The Contractor shall install the undercrossing to meet requirements of Canadian National Railway.

2. The Contractor shall observe work requirements stipulated in any permit condition.

3. Auger boring shall not begin until the following tasks have been completed:
a. All required Submittals have been provided, reviewed, and approved by the Engineer.
b. Settlement monitoring baseline values have been established. See Special Provisions for Temporary Shoring for settlement monitoring requirements.
c. All required permits and notice(s) to proceed have been received.
d. Launching pit and support systems have been completed. Locations and elevations of launching/receiving pits shall have been surveyed to confirm that work can be completed in accordance with alignment and grade shown in the plans.
e. The location, orientation and grade of the guide rails and entry/exit eye have been surveyed to ensure they are on the proper line and grade and to verify that they are properly supported. Special care shall be taken when setting the guide rails or jacking frame in the launching pit to ensure stability and accuracy of the alignment and grade. Guide rails or jacking frame shall be securely attached to the concrete working slab, with supplementary concrete or grout if necessary, to prevent movement or shifting during the work.
f. A startup inspection of all mechanical and hydraulic systems associated with the auger boring operations has been completed. The system shall be tested on the surface to ensure that the auger boring machine and supporting equipment is functioning properly.

C. Existing Utilities.
The Contractor shall confirm locations of all known existing utilities prior to starting pit excavation, auger boring and pipe installation.

D. Launching and Receiving Pit Installation.
Launching and receiving pit installation shall be completed in accordance with Special Provision, Temporary Shoring.

E. Ground Improvement.
Ground improvement shall be performed in accordance with Special Provisions for Ground Improvement.

F. Control of Water.
Control of water shall be completed in accordance with Special Provisions for Temporary Dewatering System.

G. Settlement Monitoring.
Settlement Monitoring shall be performed in accordance with Special Provisions for Temporary Shoring.

H. Auger Boring Operations.

1. Select necessary equipment and methods to install casing and carrier pipe as shown in the plans. Selected equipment shall be capable of accurate alignment and grade control, and shall protect against subsidence or other disturbance of ground, existing utilities, existing road surfaces, existing railroad facilities, and other existing structures. Provide suitable auger boring equipment and thrust block to carry out the work.

2. Transport the casing pipe from storage to the launching pit without damage. Transport methods shall be acceptable to the casing pipe manufacturer. Damaged casing pipe shall not be used in the work, unless approved in writing by the Engineer. The casing pipe shall be set on properly supported guide rails.

3. The axial forces from the thrust jacks shall be distributed to the casing pipe uniformly to prevent damage to the ends of the pipe.

4. Jacking pipe sections shall be jacked into position following the design line and grade without damaging the pipe.

5. Auger boring shall be completed in accordance with approved Submittals, and all applicable permit conditions.

6. Verify the casing pipe's minimum wall thickness is adequate for anticipated jacking loads.

7. Provide means of steering casing to ensure allowable tolerance can be achieved.

8. Provide lubrication during auger boring operations.

9. Auger boring operations shall control surface settlement and heave above the pipeline to prevent damage to existing utilities, facilities, and improvements. Repair any damage resulting from construction activities, at no additional cost to the Contracting Authority and without extension of the project schedule. Pressure grout any voids cause by or encountered during the auger boring operation. Modify equipment and procedures as required to avoid recurrence of excessive settlements or damage.

10. When obstructions are encountered at the tunnel heading, notify the Engineer immediately.

11. Completely contain, transport, and dispose of all excavated materials and fluid additives away from the construction site as specified in Section 3.N, Cleanup and Disposal.

12. If it is necessary to abandon a bored hole, remedial measures shall be taken, subject to the approval of the Engineer and approval of the owner of the facility being crossed.

I. Control of Line and Grade.

1. Establish and protect benchmarks as necessary prior to the start of construction.

2. After establishing all required bench marks, use these benchmarks to furnish and maintain all reference lines and grades for auger boring. The horizontal coordinates and elevation of survey points shall be to an accuracy of 0.01 foot.

3. The casing pipe shall be installed in accordance with the following tolerances:
   a. Variations from Design Line: 9 inches, maximum.
   b. Variations from Design Grade: 2 inches, maximum.

4. The auger and casing advancement shall be controlled to maintain line and grade within the tolerances specified. If the installation is off line or grade, attempt to make the necessary corrections, as per the approved contingency plans. The Contractor is fully responsible for the accuracy and tolerance of the auger boring operation and the correction of it.

5. Monitor line and grade continuously during auger boring operations. Record deviations with respect to design line and grade at least once per 25 feet and submit records to Engineer as requested.

J. Steel Pipe Casing Welded Joints.
Welds shall be continuous, complete joint penetration (CJP) butt joint welds as required for rigid and watertight connections.

K. Contact Grouting.
No contact grouting is required.

L. Carrier Pipe Installation.

1. Install casing spacers to each length of carrier pipe in such a manner that electrical continuity will not occur between the casing pipe and carrier pipe. Spans between spacers shall be per casing spacer manufacture's recommendations.

2. Check each joint makeup and pipe segment prior to pushing the carrier pipe segments into casing.

M. Backfill Grouting.

1. Backfill grouting shall commence only after carrier pipe placement has been performed.

2. Grout in the mixer and holding tanks shall be continuously agitated.

3. Grout holes shall be protected from becoming clogged or obstructed prior to grouting by means of a cap or other suitable device on the collar of the hole. Any hole that becomes blocked or otherwise unsuitable for its intended purpose shall be cleaned out in a satisfactory manner or replaced at the Contractor's expense.

4. A bulkhead shall be constructed at the open end of each reach of pipe to be backfilled so the annular space will be completely backfilled. Bulkheads shall incorporate a minimum 1-inch diameter drainpipe in the invert of the casing to facilitate drainage of any tunnel water during backfill grouting. This pipe shall be securely capped and plugged once backfill grout begins to flow from the drain line. An opening and piping if necessary shall be provided in the tunnel crown to allow entrapped air to escape. Vent outlets shall be provided.

5. The Contractor shall take all necessary precautions to protect and preserve the casing and the carrier pipe from damage. Spills shall be minimized and shall be cleaned up immediately. Any damage to the casing or the carrier pipe caused by or occurring during the backfilling operations shall be repaired by a method approved by the Engineer, at no cost to the Department.

6. All void space outside of the carrier pipe shall be completely filled with backfill grout. Backfill grout shall be placed in accordance with approved submittals.

7. Backfill grout shall be placed through horizontal grout pipes inserted into the annular space at locations determined by the Contractor. Begin grouting at a previously completed segment or a bulkhead located most distant from the bulkhead adjacent to open space, and proceed in the direction away from the starting point so as to cause any water remaining in the invert to move ahead of, and not mix with or become trapped by, the backfill grout. Begin grouting at the low end and proceed to the high end. Provide means to allow water and thinned or contaminated grout at the leading edge of the lift to escape.

8. A return port shall be placed at the top of the high end bulkhead. The grout return through the port shall act as the termination criteria. The grout return through the port shall act as the termination criteria.

9. Pressure gauges of appropriate range for monitoring the backfill concrete injection pressures shall be located in the line transporting the backfill grout at the point of injection. Injection pressure shall be in accordance with the approved submittal, but not exceed 15 psi at the point of injection for grouting stages below the crown of the pipe. Injection pressures shall not exceed 60 psi at the point of injection for the final stage that fills the void at the crown of the pipe. Lower pressures may be required to prevent carrier pipe movement or damage.

10. The volume of backfill grout injected shall be measured, recorded and compared with the anticipated volume per foot of pipe backfilled.

11. Prevent the carrier pipe from floating during placement of backfill grout.

N. Cleanup and Disposal.
After completion of auger boring and carrier pipe installation, all construction debris, spoils, oil, grease, and other materials shall be removed from the tunneled casing, launching and receiving pits, and all contractor work areas. Cleaning shall be incidental to the construction.

150242.04 METHOD OF MEASUREMENT.
Measurement for Auger Boring, in feet, is along the centerline of the horizontal alignment and will be the quantity shown in the contract documents.

150242.05 BASIS OF PAYMENT.

A. Payment for Auger Boring will be at the contract unit price per linear foot.

B. Payment is full compensation for:
- Furnishing and installing thrust block.
- Furnishing and installing casing by auger boring.
- Furnishing and installing casing spacer.
- Furnishing and placing backfill grouting.
- Furnishing and providing line and grade control.