

**ITEM 908 TUNNEL**

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**908.01 Description.** This work consists of the construction of a tunnel and pipe sewer. The work includes the excavation, removal of water, furnishing and installing a tunnel liner, and the construction of the tunnel end bulkheads as shown on the plans and specified in this section. Provide a tunnel liner of sufficient size to accommodate the placement of the sewer and fill material, grouting, the placement of a paved tunnel liner invert or sewer pipe support structure, and laying the sewer pipe. The Contractor may use Item 909 as a substitute, if conditions warrant and if approved by the Engineer.

**908.02 Materials.** Use the following materials:

- 1. Tunnel liner ..... 908.06
- 2. Cement for grout ..... 701
- 3. Sand for grout ..... 703.03
- 4. Concrete, Class A ..... 499, 905
- 5. Pipe sewer ..... 901.02
- 6. Controlled density fill mixes, cementitious material for fill..... 613, 912.02

**908.03 General.** Ensure tunneling within the right-of-way of private companies and public agencies conforms to the requirements and regulations of the respective companies or agencies. Before proceeding with the tunneling work, prepare and submit to the Engineer for approval, the necessary working schedule, a description of the type of materials planned for use in the work, and the planned methods of construction. Submit shop drawings, accompanied by calculations, and stamped by a Professional Engineer registered in the State of Ohio, showing the adequacy of the liner materials and shield, if used. Furnish one electronic copy or six (6) paper copies of the shop drawings to the Engineer. The Engineer will forward copies to any authority involved for authority approval. The Engineer will return one approved copy to the Contractor. Pay any costs that may result due to the authority's requirements, of whatever nature, including furnishing of watchmen and supervision by the authority's forces.

Where work under this item involves tunneling under of railroad tracks, all operations of the Contractor or his agents and employees must be subordinate to the free and unobstructed use and conduct of the railroad company's business without delay or danger to life, equipment or property. The Contractor shall save harmless the railroad company against all claims, suits or judgments arising because of or resulting from the

operations, actions or omissions of the Contractor or his agents and employees. The Contractor shall carry on his operations in such a manner that all work shall be performed below track level and without obstructions on the railroad roadbed.

**908.04 Construction Layout and Alignment Holes.** The City will locate and reference the centerline of the project. Protect and replace control points set by the City. Use competent personnel and suitable equipment for the layout work required and provide supervision of the work by a Registered Professional Engineer or a Registered Surveyor. Submit field notes of all layout work to the City.

For tunnels greater than 400 feet (122 m) in length, drill alignment holes, unless otherwise directed by the Engineer. Drill alignment holes at a maximum of 400 feet (122 m) apart along the centerline. Drill additional alignment holes if the Engineer determines that the tunnel is not on line and grade within the limits specified. Drill the holes to such depth as is necessary for the casing to extend into the tunnel excavation. Provide a casing of adequate size and strength, 6 inch (152 mm) minimum, to line the hole. Set the casing vertically.

Where a hole is located in the existing pavement, cut the pavement before drilling the hole. After the casing is in place, insert a suitable, substantial cover in the casing at street grade, and fill the space outside the casing with concrete.

Following completion of the tunnel liner, the Contractor may use the alignment holes for grouting voids. After completion of the pipe installation and grouting, fill the alignment holes with controlled density fill material in accordance with Item 613.

**908.05 Tunnel Shield.** The City recommends use of a tunneling shield for all liner plate installations and requires the use of a tunneling shield on all railroad installations.

If required, use a steel shield designed to support the loading from the installation. Provide a hood or an approved grid system to protect the advancing face with sufficient length to install 1 complete ring of liner plates or one set of ribs and lagging within the shield before advancing. Ensure the hood or approved grid system does not exceed the outside dimensions of the tunnel liner plate installation by more than 1 inch at any point on the periphery.

Adequately brace the shield and provide appurtenances for completely bulkheading the face (submit details with the design information).

**908.06 Tunnel Lining.** Install the tunnel liner providing strength commensurate with the tunnel diameter and depth of cover and in accordance with the design requirements of the private or public authority involved. Before initiating construction, provide the liner details, reasons for selecting the liner supports and materials, and calculations demonstrating the adequacy of the method of tunnel liner support to the Engineer.

When using ribs and lagging for tunnel lining, use a rib expander to expand the rib outward and upward by a continuous contact between the rib expander and the rib.

Provide tunnel liner plates with a minimum of 12 gage, hot rolled, structural quality carbon steel plates conforming to ASTM A-569. Offset each ring by rotating the starting plate, so that end flanges of the adjacent rings do not fall in line.

**908.07 Excavation.** Excavate all material of whatever nature encountered, including rock, necessary for the construction of the work. Consider all excavated material as

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unclassified material. Do not advance excavation beyond the edge of the shield, except in rock.

**908.08 Soil Stabilization.** The Engineer may direct pressure grouting of the soils or freezing of the soils before jacking, boring, or tunneling to stabilize the soils, control water, prevent loss of material and prevent settlement or displacement of embankment. Use cement or chemical grout or other special injection material selected to accomplish the necessary stabilization.

Submit a plan prepared by a Registered Professional Soils Engineer, or by an experienced and qualified company specializing in this work detailing the materials planned for use in the work and the proposed injection method. . Submit to the Engineer for approval before starting work. Include proof of experience and competency with the submission. If Soil Stabilization is required by the changed conditions as described in 104.02, the City will pay for this work in accordance with 104.02.

**908.09 Dewatering.** When the Contractor expected to encounter water, provide and maintain pumps of sufficient capacity to handle the flow at the site. Closely observe the dewatering process to detect any settlement or displacement of railroad embankment, tracks, pavement, and other facilities.

**908.10 Grouting.** Keep grouting as close to the heading as possible, using grout stops behind the liner plates, if necessary. Provide grout holes in the tunnel lining with a spacing not to exceed 4.5 feet (1.4 m) measured longitudinally. Vary the location of holes around the periphery of the tunnel lining to suit field conditions, permitting the proper grouting sequence to ensure complete filling of void spaces outside the tunnel lining (recommended initial spacing at 3 feet (0.9 m)). Fill all the void space outside the tunnel lining caused by the tunneling with 1:3 (cement:sand) cement grout. Perform grouting if ordered by the Engineer. Do not progress the tunnel more than 6 lineal feet (1.8 m) beyond the grouting without prior written approval of the Engineer. Grout all completed sections if work is suspended for more than 24 hours. Start the grouting at the lowest hole in each grout panel and proceed upward simultaneously on alternating sides of the pipe. Install a threaded plug in each grout hole when the grouting is completed at that location. Bulkhead the face of the tunnel by approved methods whenever the job is vacated or if directed by the Engineer.

Use a grouting machine that applies a pressure up to 75 pounds per square inch (517 kPa) in excess of any external water pressure. Provide a grouting machine with a gauge that accurately indicates working pressure. Monitor the gauge during grouting operations. Do not exceed the pressure considered safe or that would distort the tunnel lining or that would lift and/or displace the overburden. Use grout pipes with a minimum of 1 ½ inches (38 mm) inside diameter. In freezing temperatures, heat mixing water for grout and provide proper insulation to prevent grout from freezing in grout tubes from point of initial discharge to final position of grout in place.

**908.11 Fill Material.** After installation of the sewer in the tunnel lining, completely fill the space between the tunnel liner and the sewer with 1 to 5 Portland Cement grout, or Class A concrete, or Item 613 Flowable Controlled Density Fill mixes.

**908.12 Method of Measurement.** The Engineer will measure the length of tunnel and appurtenances by the actual number of linear feet (meters) accepted, as measured

along the centerline of the sewer, complete in place. When the tunnel shaft is included in the tunnel unit prices, the Engineer will measure from the center of the tunnel shaft.

**908.13 Basis of Payment.** The City will pay the accepted number of linear feet (meters) of tunnel for the pipe sizes specified at the contract unit prices per linear foot (meter) complete in place. Include the cost of the tunnel shaft in the unit price bid for the tunnel, unless a separate bid item for Tunnel Shaft (Item 920) is included in the contract. If the shaft is included with the tunnel unit prices, the City will pay from the center of the shaft to the end of the tunnel. If a separate bid item for Tunnel Shaft (Item 920) is included, the City will pay for the tunnel starting 1.33 feet (0.4 m) inside the outside wall of the shaft.

The City will pay for the sewer pipe under Item 901.

The City will pay under:

<b>Item</b>	<b>Unit</b>	<b>Description</b>
908	Linear Foot (Meter)	Tunnel for ____ Inch (mm) Diameter Pipe, Including Shaft
908	Linear Foot (Meter)	Tunnel for ____ Inch (mm) Diameter Pipe, Excluding Shaft