SECTION 02445
AUGER BORING AND ALTERNATIVE TUNNELING

PART 1. SCOPE

A. The Work to be performed herein shall consist of the installation of a casing pipe for the purpose of installing a carrier pipe as shown on the drawings or as called for in these specifications. It shall include the excavation of a boring pit, auger boring between the points specified on the drawings, or as directed by the OWNER, installation of the carrier pipe, and disposing of the excavated materials in the manner herein provided.

B. Insurance for Railroad Crossing: The CONTRACTOR shall, at its expense, secure and maintain throughout the construction period the appropriate insurance as required by the agency having jurisdiction.

1.02 DESIGN CRITERIA

A. Design boring and receiving pits, excavation support systems to withstand lateral earth pressures, ground loads, unrelieved hydrostatic pressures, bottom heave, equipment loads, applicable traffic and construction loads, and other surcharge loads to allow safe construction of boring and receiving pits without appreciable movement or settlement of ground, and to prevent damage to or movement of adjacent structures, streets, utilities and trees.

B. Design excavation support systems and casing installation equipment to be compatible with geologic conditions described in the Geotechnical Report**.**

1.03 SUBMITTALS

A. Action Submittals
   1. Casing pipe material including the standard to which it is manufactured, outside diameter, wall thickness, and joint configuration.
   2. Details of casing spacers, including manufacturer's recommended spacing.
   3. Details of end seals.
   4. Boring and jacking plan.
   5. Means and method of dewatering.

1.04 QUALIFICATIONS

A. Bore and jack operations shall be performed by a CONTRACTOR or Subcontractor with at least 5 years of experience involving work of a similar nature

PART 2. PRODUCTS

2.01 CASING PIPE

A. The casing pipe shall be steel meeting the latest approved American Railway Engineering Association "Specifications for Pipelines for Carrying Flammable and Nonflammable Substances."

B. Unless otherwise required by the agency having jurisdiction, the steel casing pipe shall have a minimum yield strength of 35,000 psi and shall have the minimum wall thickness shown in the following table:

TABLE OF MINIMUM WALL THICKNESS FOR STEEL CASING PIPE FOR E72 LOADING

CARRIER PIPE	CASING PIPE	NOMINAL THICKNESS
2	6	0.344 inch
4	8	0.344 inch
6	12	0.344 inch
8	16	0.375 inch
10	20	0.407 inch
12	24	0.469 inch
14	27	0.505 inch
16	30	0.505 inch
18	30	0.505 inch
20	36	0.595 inch
24	36	0.595 inch

C. When the casing pipe is installed without benefit of a protective coating, the wall thickness shown above shall be increased to the nearest standard size, which is a minimum of 0.063 inch greater than the thickness shown.

2.02 CARRIER PIPE

A. The carrier pipe shall be the same material as the pipeline unless otherwise directed by the OWNER.

B. The carrier pipe for natural gas shall be approved coated steel or polyethylene pipe as specified in the material specifications section.

C. All carrier pipes shall be restrained joint in the casing.

2.03 GROUT HOLES

A. Furnish casing pipe with 2-inch diameter preformed grout holes at centerline and crown for pressure grouting. Spacing of grout holes shall not exceed 5 feet.

2.04 GROUT FOR FILLING VOIDS OUTSIDE CASING

A. Neat cement grout with a minimum compressive strength of 500 psi.

2.05 FILL MATERIAL FOR ANNULAR SPACE BETWEEN CASING PIPE AND CARRIER PIPE

A. Fill material is not required in the annular space. CONTRACTOR shall provide plastic chocks to minimize annular space between casing and fabricated casing spacer device.

2.06 CASING SPACERS

A. Fabrication:
   1. Polyethylene spacers shall be used on pipe up to 12-inch diameter. For larger pipes, spacers shall be carbon steel or stainless steel and include a PVC or neoprene liner.
   2. Spacer Band Material: Carbon steel coated with fusion bonded epoxy or Type 304 stainless steel.
   3. Spacer Width: As recommended by spacer manufacturer for the specific application**.**
   4. Spacer Runners:
      a. Suitable for supporting the weight of carrier pipe.
      b. Manufactured of material having a low coefficient of friction and designed to support the carrier pipe without damage or excessive wear.
   5. Size: Sufficient to provide a minimum clearance of 2 inches between outside of carrier pipe bells or couplings and inside of casing.

B. Manufacturers:
   1. Pipeline Seal and Insulator, Inc. (PSI), Houston, TX.
   2. Advance Products and Systems, Inc., Lafayette, LA.
   3. Cascade Waterworks Mfg. Co., Yorkville, IL.

2.07 CASING END SEALS

A. Synthetic rubber, conical shape, pull-on or wrap-around style with Type 304 stainless steel bands.

B. Manufacturers:

1. Pipeline Seal and Insulator, Inc. (PSI), Houston, TX.
2. Advance Products and Systems, Inc., Lafayette, LA.
3. Cascade Waterworks Mfg. Co., Yorkville, IL.

PART 3. EXECUTION

3.01 EXAMINATION

A. Confirm location of all known existing utilities prior to start of jacking/receiving pit excavation and pipe installation.

B. The OWNER will provide the necessary control points required by the CONTRACTOR for this construction. The CONTRACTOR shall provide the detailed layout required to keep the tunnel or bore on grade.

3.02 SHAFT/PIT INSTALLATION

A. Notify OWNER not less than 15 working days before beginning shaft excavation.

B. Methods of construction for jacking/receiving pits shall be such as to ensure the safety of the Work, CONTRACTOR's employees, the public, existing utilities, and adjacent property and improvements, whether public or private.

C. Before beginning construction of jacking/receiving pit, adequately protect existing structures, utilities, trees, shrubs, and other existing facilities.

D. Provide complete groundwater control for excavations at all time.

E. Perform jacking/receiving pit excavations using appropriate excavation or large hole drilling methods, as required.

F. Place fencing, gates, lights, and signs, as necessary around shafts and staging areas to provide for public safety.

G. Inspect shaft/pit excavations daily to check safety of excavation and structural integrity of support system.

3.03 EQUIPMENT SELECTION

A. Select necessary equipment and methods to install casing and carrier pipe as shown on Drawings. 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 surface, railroad facilities and existing structures**.**

3.04 LUBRICATION OF CASING EXTERIOR

A. Bentonite slurry may be used to lubricate exterior of casing during installation.

3.05 BORING

A. The boring shall be accomplished by means of auguring to the size, line, and grade shown on the Drawings or as directed by OWNER. The hole diameter shall be essentially the same as the outside diameter of the casing pipe.

3.06 INSTALLATION OF CASING PIPE

A. Verify casing pipe minimum wall thickness is adequate for anticipated jacking loads.

B. Hole diameter shall not exceed outside diameter of casing pipe by more than 1 inch.

C. Where unstable soil conditions are found to exist, conduct boring operations in a manner that will not be detrimental to facility being crossed.

D. Tolerance shall be as follows:
   1. Line Tolerance: 2 inches, maximum.
   2. Grade Tolerance: 2 inches, maximum.

E. Provide means of checking line and grade at all times to confirm allowable tolerance has been achieved.

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

G. Jack the steel casing pipe into place as the boring proceeds. Weld sections of casing pipe together to provide watertight joints by operators qualified in accordance with the American Welding Society Standard Procedures.

   1. Welds shall be continuous, complete joint penetration (CJP) butt joint welds as required for rigid and watertight connections.

H. Do not remove unacceptable casing without prior approval from OWNER. If the removal of casing pipe is permitted, make proper provisions to prevent caving in of the earth surrounding the casing.

I. If necessary to abandon a bored hole, remedial measures shall be taken by CONTRACTOR, subject to review by OWNER of facility being crossed.

3.07 CORRECTION OF GRADE

A. If required grade tolerance has not been achieved, correct grade using casing spacers of varying height.

3.08 MONITORING OF SURFACE MOVEMENT

A. Perform a preconstruction survey of road surface or railroad tracks. Record horizontal coordinates and elevations. Mark location of where measurements were taken. Monitor movement of road surface or railroad tracks on a daily basis and provide results to OWNER. Stop operations if movement exceeds 1/4 inch and immediately notify the OWNER.

3.09 GROUTING BORED AND JACKED CASINGS

A. Exterior Voids:

1. After casing has been jacked into position, pressure grout through grout holes provided to fill voids outside of casing.
2. Start grouting at centerline hole at one end and pump grout until grout appears in grout hole at the crown, then start grouting through opposite spring line hole until grout appears at hole in crown.
3. Grout through hole at crown until grout appears in next set of holes along casing.
4. Plug holes at starting point and move to next set of holes and repeat grouting sequence until full length of casing has been grouted.

3.10 INSTALLATION OF CARRIER PIPE (See Figure 1-02445-a)

A. Entire length of casing shall be installed complete and inspected and approved by OWNER before any carrier pipe is placed therein. Repair defects in casing pipe or leakage at joints.

B. Install a minimum of three casing spacers to each length of carrier pipe in such a manner that electrical continuity will not occur between casing pipe and carrier pipe. Spans between spacers shall be as shown on Drawings or as directed by the OWNER.

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

D. When the carrier pipe is a ductile iron or PVC pressure pipe install restrained joint pipe or mechanical joint with restrainers, unless otherwise directed by OWNER.

E. Casing end seals shall be provided at the end of the casing pipe after installation of the carrier pipe.

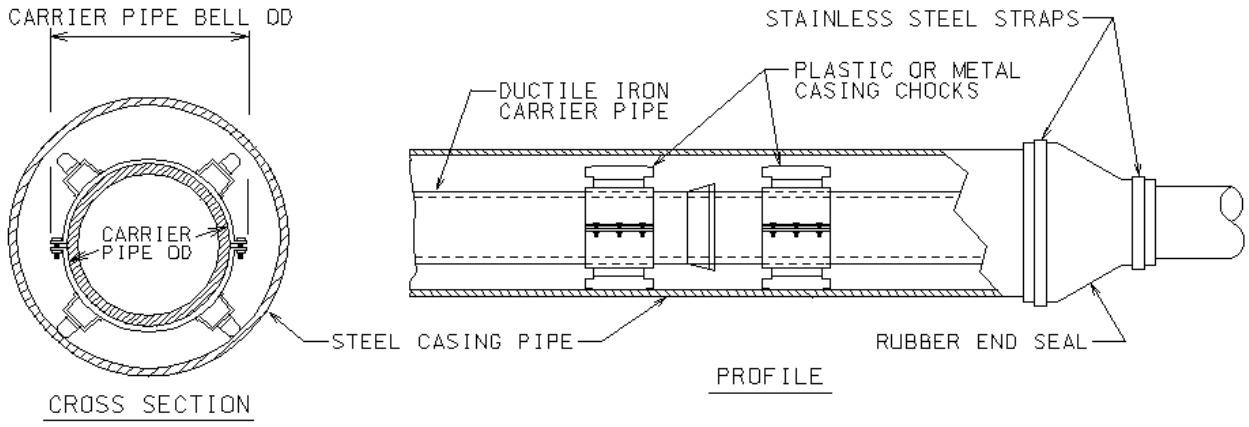

Figure 1-02445-a (Standard Carrier/Casing Pipe Details for Water and Sanitary Sewer Lines)

Notes:

I. Casing spacers to be spaced as directed by OWNER or shown on the drawings.

II. Plastic or stainless casing spacers shall be a minimum of 4" long or as directed by OWNER.

III. OWNER will direct whether the casing spacers will be standard, center, or bottom restrained.

3.11 CASING PIPE AND CARRIER PIPE ANNULAR SPACE

A. The annular space shall be left empty.

3.12 REMOVAL OF JACKING/RECEIVING PIT SUPPORT SYSTEM

A. Remove support elements, except those required by OWNER to remain in place, from excavation in upper **f**ive (5) feet below ground surface. In addition, remove support elements as needed to install the pipeline.

B. Removal of support system shall be performed in a manner that will not disturb or harm adjacent construction or facilities.

C. Fill voids created by removal of support system with clean sand as approved by OWNER.

3.13 BACKFILLING OF JACKING/RECEIVING PIT

A. Seal jacking/receiving pit opening and backfill at shafts when no longer required.

B. Backfill shall be as specified in Section 02321, Excavation, Bedding, and Backfill for Utilities.

3.14 GUARANTEE OF WORK

A. Guarantee a usable completed casing between the points specified and to the line and grade specified. The allowable tolerance at the downstream end point of the bore shall be such that the invert of the carrier pipe may be positioned within a vertical area limited on the top by an elevation no higher than the elevation shown on the drawings and on the bottom by an elevation no lower than the existing inlet pipe invert. For sewers, the sides shall be a minimum of 8 inches inside the interior face of the manhole at the end of the bore.

B. The allowable tolerance at the upstream end point of the bore shall be such that the invert of the carrier pipe may be positioned at the elevation shown on the drawings.

3.15 TUNNELING ALTERNATIVE

A. In the event boring and jacking is impossible because of pipe size rock, or other factors as determined by the OWNER, and the highway department or railroad will not permit open cutting, make crossings by tunneling using liner plates. Conduct tunneling operations as approved by the OWNER and the agency having jurisdiction of the facilities. If voids are caused by the tunneling operations, fill by pressure grouting or by other approved methods that will provide proper support.

B. After the tunnel liner plates are formed to shape, the plates shall be galvanized on both sides by the hot dip process. A coating of prime western zinc, or equal, shall be applied at the rate of not less than 2 ounces per square foot of double exposed surface. If the average spelter coating as determined from the required samples is less than the amount specified above, or if any one specimen shows a deficiency of 0.2 ounce, the lot shall be rejected. Spelter coating shall be first class commercial quality, free from injurious defects such as blisters, flux, and uncoated spots.

C. The inside and outside of the plates shall be given a bituminous coating meeting the AASHO M-190 Specifications for bituminous protected corrugated metal pipe.

D. Construct the tunnel and completely line on the inside with structural steel liner plates meeting all requirements specified herein. The dimensions, of the tunnel, shall be as shown on the drawings or as specified by the OWNER.

E. The tunneling operation is to commence from a pit no larger than required, and sheeted and shored, if necessary. The CONTRACTOR shall furnish line and grade stakes.

F. All excavation, for the entire length of the tunnel, shall be done by tunneling, and the work may be done from either end, but not both. Trim the periphery of the tunnel smooth to fit the outside of the steel liner plate as nearly as is practical, and fill all space outside of the steel liner plate with a sand-cement grout mixture.

G. Install the steel liner plates immediately after the excavated material has been removed. Do not remove material more than 24 inches ahead of the installed liner plates.

H. Provide all necessary bracing, bulkheads, and/or shields to ensure complete safety to traffic at all times during the progress or the work. Perform the work in such a manner as to not interfere with normal traffic over the work.

I. The steel lining shall consist of plates 16 or 18 inches wide, and each circumferential ring shall be composed of the number and length of plates necessary to complete the required diameter.

J. The inside diameter of the completed ring shall be as shown on the drawings or as specified by the OWNER, and no part of the plate or reinforcing ribs will be allowed to extend inside this net diameter.

K. The strength of the tunnel lining will be determined by its section modulus. In no case shall it be less than 0.0590 inch cubed per inch of plate width based on the average for one ring of plates. Thickness of the metal for these steel plates shall be not less than 10 gauge, allowing for standard mill tolerances. The tunnel strength shall be equal to AASHO railroad E80 loading at the appropriate depth of cover.

L. All plates shall be punched for bolting on both longitudinal and circumferential seams and shall be fabricated so as to permit complete erection from the inside of the tunnel. The longitudinal seam shall be of the lap type with an offset equal to the gauge of metal for the full width of the plate, including flanges, and shall have staggered bolt construction fabricated to allow the cross section of the plate to be continuous through the seam. All plates shall be of uniform fabrication, and those intended for one size tunnel shall be interchangeable.

M. The material used for the construction of these plates shall be new and unused and suitable for the purpose intended. Workmanship shall be first class in every respect.

N. Pour a 6- inch carrier pad to grade using a grout mixture prior to carrier pipe.

O. Install the carrier pipe to the line and grade shown on the drawings or as specified by the OWNER. After the carrier pipe is installed adequately, place support and securing jacks at a longitudinal distance not to exceed 8 feet as shown on the Standard Drawing herein. Block the carrier pipe and backfill the space between the carrier pipe and the tunnel liner with sand by a method approved by the OWNER. The CONTRACTOR shall be responsible for securing an adequate water supply for the installation of the sand.

P. The tunnel shall be grouted every 10 feet or every five consecutive calendar days (including weekends and holidays), whichever comes first, or at more frequent intervals as determined by the OWNER. This grout shall include filling all voids outside of the liner plates with a sand-cement grout mixture to prevent settlement.

END OF SECTION