

Section 2

Gravity Sewers

A. General

1. All designs shall conform to good engineering practice and shall meet the requirements of the Pennsylvania Department of Environmental Protection (PADEP), Occupational Health and Safety Administration (OSHA), Pennsylvania Department of Transportation (PennDOT) and the Pennsylvania Department of Labor and Industry, and shall conform to the requirements contained herein.

2. Permits

The Applicant shall secure, in the name of the Authority, all permits that are required from PADEP, Conrail and PennDOT. The Applicant shall secure, in his own name, all required construction permits such as highway or local street opening permits. Any existing street, highway or other improvements disturbed during construction shall be restored to the satisfaction of the appropriate municipality or Owner before the facilities will be accepted for dedication by the Authority. All costs of such permits, including any and all bonds required, shall be the sole expense of the Applicant.

B. Design Criteria

1. Diameter and Slope

The minimum sewer diameter shall be 8 inches and the minimum slope for all gravity sewer shall be as listed in the PADEP "Domestic Wastewater Facilities Manual". The minimum slope for all terminal sections of sewers shall be 1.0%. The maximum distance between manholes shall be 400 feet for mains 15" or less in size.

2. Depth of Sewers

- a. All sewers shall be designed to provide a minimum depth of cover of 3'-6" above the top of the pipe.
- b. Under normal conditions, sewer lines with depths greater than 15 feet will not be approved. If greater depths of sewers are deemed necessary, the design should be thoroughly evaluated and discussed with the Authority prior to formal submission of the plans for approval. In all cases where subsequent approval is given by the Authority, the pipe shall be ductile iron.

3. Separation of Utilities

The Authority's interpretation of the PADEP requirements for 10-foot horizontal and 18-inch vertical separation distances between sewerage and water utilities is as follows:

a. Parallel Installation

A minimum 10-foot horizontal separation (measured from edge of pipe to edge of pipe) between sanitary sewer lines and water lines shall be required when the lines are constructed parallel (relatively) to one another. When this condition cannot be met, concrete encasement of the sanitary sewer line shall be required for the entire length of the line that fails to meet the 10-foot separation distance requirement, at the discretion of the Authority's Engineer. However, under no conditions shall the horizontal separation distance between sewer and water lines be less than 6 feet.

b. Line Crossings

A minimum 18-inch vertical separation between the top of the sanitary sewer line and the bottom of the water line shall be required when the lines cross one another. When this separation cannot be met, concrete encasement of the sanitary sewer line shall be required for a minimum distance of 10 feet on either side of the point of crossing, and/or until the minimum 10-foot separation distance requirement is met (depending on the angle of crossing).

Where a water main crosses below a sewer main, structural support must be provided for the sewer main to prevent any damage to the water main.

These requirements shall apply to laterals (both water and sewer) as well as main line construction.

4. Borings

Bored crossings shall be done in accordance with PennDOT requirements.

C. Materials and Equipment

1. Ductile Iron Pipe and Fittings

(References to ASTM, AWWA and ANSI Specifications imply latest edition.)

a. Ductile Iron Pipe

Ductile iron pipe shall conform to AWWA C151 and ASTM A746. Pipe shall be supplied in standard lengths as much as possible and shall be by

U.S. Pipe and Foundry Company, American Ductile Iron Pipe Company or Griffin Pipe Products Company.

b. Joints

Joints shall be rubber-gasket push-on type or rubber-gasket mechanical joint type conforming to AWWA C111. Gasket shall be of SBR.

c. Linings

Ductile iron pipe and fittings shall be lined with Protecto 401 ceramic-filled amine cured epoxy by Indurall, SewperCoat calcium aluminate mortar by Lafarge Calcium Aluminates or approved equal.

d. Minimum Thickness

Thickness design shall be per AWWA C150, except provide minimum Class 350.

2. Polyvinyl Chloride Sewer Pipe and Fittings

a. Materials

Polyvinyl chloride (PVC) sewer pipe and fittings shall be PVC SDR 35 with full diameter dimensions and shall conform to ASTM D3034 for sizes 6 (for sanitary sewer laterals) through 15 inches and shall conform to ASTM F679 for sizes 18 through 36 inches.

PVC Schedule 40 pipe shall be used for 4-inch pipe (for service lines). PVC Schedule 40 pipe shall conform to ASTM D1785.

b. Joints

PVC pipe and fittings shall have bell and spigot push-on joints. The bell shall consist of an integral wall section with a solid cross-section elastomeric gasket (as manufactured by J.M. Manufacturing Co. or approved equal) securely locked in place to prevent displacement during assembly. Installation of elastomeric gasketed joints and performance of the joint shall conform to ASTM F477, ASTM D3139 or ASTM D3212.

3. Alternative Gravity Sewer Pipe Materials

Alternative gravity sewer pipe materials may be considered and will be subject to approval by the Authority on a case-by-case basis. Full details of alternatives must be submitted.

4. Steel Casing Pipe

- a. The steel casing pipe shall have a minimum yield strength of 35,000 psi, have a thickness as required but not less than 0.375 inches, be equipped with grout holes and conform to AWWA C200 and ASTM A53.
- b. Casing interior and exterior shall be painted with two coats bitumastic enamel coating in accordance with AWWA C203.
- c. Pipe cradles or isolators shall be as shown on the detail drawing, APS casing spacers, Model SSI or approved equal.
- d. Minimum casing diameter shall be in accordance with PennDOT or Amtrak requirements as applicable.

D. Installation

1. Excavation

- a. The trench shall be excavated to a depth of six inches below the outside diameter of the pipe barrel, or deeper if so specified. The width of the trench shall be as shown on the detail drawings. The resultant subgrade shall be undisturbed, or compacted as approved by the Engineer if disturbed.
- b. When the pipe is to be laid in fill, bring the fill to two feet above the elevation of the top of pipe to be laid before excavation commences. Compact fill to 95% of the maximum density as determined by ASTM D1557-70 or AASHTO T-180, Method D (Modified Proctor). The bottom of the trench shall be compacted to 95% of maximum density prior to installation of the pipe bedding.

2. Bedding

- a. The pipe shall be bedded on 6" of AASHTO 8 (PennDOT 1B) stone, the full width of the trench (a minimum of 6" on either side of the pipe), and shall be covered with AASHTO 8 (1B) stone to a height of 12" over the top of the pipe. The bedding shall be thoroughly compacted. The bedding shall provide uniform and continuous bearing and support for the pipe at every point between the bells.
- b. Flowable fill shall also be an acceptable material for trench bedding and backfill and shall conform to PennDOT Form 408 Type B flowable backfill.
- c. If potentially corrosive materials are encountered, polyethylene encasement shall be installed to protect ductile iron pipe in accordance with ANSI/AWWA C105/A21.5.

d. Unstable Subgrade

Where the bottom of the trench at subgrade is found to be unstable or to include ashes, cinders, any type of refuse, vegetable, or other organic material, or large pieces or fragments of inorganic material, which, in the opinion of the Authority, should be removed, the Applicant shall excavate and remove such unsuitable material to the width and depth recommended by the Authority. Before pipe is laid, the subgrade shall be formed by backfilling with AASHTO 57 stone in 3-inch (uncompacted thickness) layers thoroughly compacted to 95% of standard Proctor density and the bedding prepared as specified above in D.2.a.

e. Special Foundations

Where the bottom of the trench at the subgrade is found to consist of material which is unstable to such a degree that, in the opinion of the Authority, it cannot be removed and replaced with an approved material thoroughly compacted in place to support the pipe properly, the Applicant shall construct a foundation for the pipe consisting of piling, timbers or other materials, in accordance with plans approved by the Authority.

f. Concrete Encasement

Pipes to be encased in concrete shall have a minimum six inches of concrete above and below the pipe and the concrete shall be extended for the full width of the trench. No formwork to limit the concrete width shall be used. Flexible pipe joints shall be provided in the pipe at a distance of three times the pipe diameter from the ends of the concrete encasement, to provide pipe articulation. Pipes shall be protected against flotation during placement of concrete encasement. This may require two-stage concrete placement combined with anchor straps.

3. Laying Pipe

- a. Ductile iron pipe and fittings shall be installed in accordance with requirements of AWWA C600. PVC pipe and fittings shall be installed in accordance with the requirements of the manufacturer and ASTM D2321. All pipes shall be laid to a uniform line and grade, bell ends upgrade, with a firm and even bearing along the barrel of the pipe. The spigot end of the pipe is to be centered in, shoved tight and secured against the bell of the previously laid pipe. The interior of each pipe shall be cleaned of all foreign material before the next pipe is laid. Pipe laying shall commence at the lowest point and proceed upgrade. At the close of each day's work, and at such other times when pipe is not being laid, the open end of the pipe shall be closed by a watertight plug or other approved means.

b. Grade and Alignment Control

At the request of the Authority, a grade sheet for each manhole run shall be furnished. Grade and alignment control shall be established by laser (direct reading).

c. Pipe Clearance in Rocks

(1) Ledge rock, boulders and large stones shall be removed to provide a clearance of at least 6 inches below and on each side of all pipe and fittings for pipes 24 inches in diameter or less, and 9 inches for pipes larger than 24 inches in diameter.

(2) The specified minimum clearances are the minimum clear distances which will be permitted between any part of the pipe and/or fitting being laid and any part, projection or point of such rock, boulder or stone.

d. Pipes at Manholes or Other Rigid Structures

Pipes directly connected to or supported by rigid structures shall not have a length beyond the rigid support in excess of that shown in the manhole detail drawings.

e. Water in Trenches

Trenches shall be dewatered prior to laying pipes. Ground and surface water in trenches shall not be permitted to enter the sewerage system.

4. Backfilling

a. The trench may be filled with excavated material above the AASHTO 8 stone as specified above except that stones larger than eight (8) inches may not go in the trench and the fill shall not contain more than 20% stone in total volume.

b. The trench shall be properly tamped in lifts not to exceed the maximum thickness for the type of tamping equipment used.

c. All bedding and backfilling shall be compacted to 95% of maximum density as determined by ASTM D1557-70 or AASHTO T-180, Method D (Modified Proctor).

d. Backfilling shall not be done with frozen material. No backfilling shall be done if the material already in the trench is frozen.

- e. In state highways, all backfill shall be in accordance with the requirements of PennDOT Chapter 459. The requirement for backfilling in other streets shall be as required by the municipality in which the street is located.

5. Surface Restoration

- a. In state highways surface restoration shall be in accordance with PennDOT requirements, or as specified in the PennDOT permit issued for the subject project.
- b. In township roads, paved areas or other traffic areas, surface restoration shall be in accordance with the requirements of the local municipality in which the street is located.
- c. All street, road or highway surfaces which are disturbed or damaged during installation of the sewers shall be properly repaired at the Owner's cost.
- d. Subsequent settlement of the street, road or highway surface resulting from improper compaction of the sewer line trench or failure to protect the sewer line trench shall be promptly repaired at the Owner's cost.
- e. The Authority may require televising and air testing of lines in settled areas to confirm the absence of sags or damage to the sewer pipe.

6. Bored Crossings

- a. The carrier pipe shall be installed to the exact line and grade required within the casing pipe using a leveling grout course, adjustable pipe supports, or other methods as approved by the Authority.
- b. The carrier pipes shall be supported within the casing pipes so that the pipe bells do not rest directly on the casing. The load of the carrier pipes shall be distributed along the casing by the method of support shown on the detail drawings.
- c. All work shall be performed in conformance with the requirements of PennDOT, Amtrak or other regulatory agencies involved.

E. Testing and Inspection

1. Notification

It is incumbent upon the Applicant to notify the Authority a minimum of 24 hours in advance of when the work will be ready for inspection.

2. Alignment Test

After the mains have been laid and backfilled, the Authority's inspector will flash a light between manholes or manhole locations to determine whether the alignment of the sewer is true and whether any pipe has been displaced, broken or otherwise damaged subsequent to laying. This test will again be conducted before final acceptance of the sewer. Each section (manhole to manhole) of sewer shall show a good light circle throughout its length and any and all defects shall be corrected to the satisfaction of the Authority before acceptance.

3. Leakage Tests

- a. Sewers shall be tested for leakage only after all sewers and sewer laterals, including stoppers, are installed. Each sewer section between manholes including all laterals will be tested with low pressure air. Testing will be done only after all backfilling has been completed and trench settlement has been minimized. The Applicant shall furnish all labor, materials, tools, equipment and accessories necessary to perform the required tests. All tests shall be made in the presence of, and to the complete satisfaction of the Authority.
- b. The equipment shall be specifically designed and manufactured for testing pipelines with low-pressure air and shall be provided with an air regulator valve or air safety valve set to prevent the air pressure in the pipeline from exceeding 9 psig. All plugs shall be braced to prevent blowout. Care must be taken so that the pressures generated by the air testing equipment do not exceed the pipe manufacturer's recommendations.
- c. The above ground air control equipment shall include a shut-off valve, pressure regulating valve, pressure relief valve, input pressure gauge and a continuous monitoring pressure gauge having a range from 0 to 10 or 15 psi.
- d. Low pressure air shall be slowly introduced into the sealed line until the internal pressure reaches approximately 5 psig. The pipe shall remain under pressure for not less than 2 minutes before the test begins, to allow equilibrium of the air temperature with the pipe wall.
- e. When the pressure has stabilized at 5 psig, the air hose from the control panel to the air supply shall be disconnected.
- f. The pipe shall be considered acceptable if the pipe holds a pressure of 5 psig for a minimum of 5 minutes.

- g. The Applicant shall repair or replace all defective material and/or workmanship and shall conduct such additional tests as required to demonstrate that the sewer meets the requirements, at no additional cost to the Authority. All materials and methods used to repair the sewer shall meet with the approval of the Authority's Engineer.

4. Cleaning

At the conclusion of the work, thoroughly clean all pipelines by flushing with water or other means to remove all dirt, stones, pieces of wood, or other material which may have entered the pipes during the construction period. Debris cleaned from the lines shall be removed from the low end of the pipe. If after this cleaning, obstructions remain, they shall be removed. After the pipelines are cleaned and if the groundwater level is above the pipe or following a heavy rain, the Engineer or the Authority will examine the pipes for leaks. If any defective pipes or joints are discovered, they shall be repaired or replaced as directed by the Engineer or the Authority.

F. Detail Drawings

Relevant detail drawings are:

- 1 Right-of-Way Restoration
- 2 Pavement Restoration
- 3 Concrete Encasement
- 4 Pipe Cradle in Casings

END OF SECTION