SECTION 70

POLYVINYL CHLORIDE (PVC) SEWER AND SERVICE PIPE

PART 1 - GENERAL

1.01 SCOPE

The work covered by this section includes furnishing all labor, equipment, and materials required to install and test polyvinyl chloride (PVC) pipe, including accessories, as shown on the Drawings and/or specified herein.

1.02 QUALITY ASSURANCE

A. The Contractor, at the Engineer's request, shall furnish a certificate from the manufacturer of the pipe and fittings that the manufacturer is fully competent and capable of manufacturing PVC sewer pipe, fittings, and accessories of uniform texture and strength that will fully comply with these Specifications and have so manufactured this class of pipe in sufficient quantities to be certain that it will meet all normal field conditions of usage. The manufacturer must have adequate equipment and quality control facilities to be sure that each extrusion of pipe is uniform in texture, dimensions, and strength.

B. Pipe shall be tested when requested by the Engineer and all pipe so designated shall be tested in accordance with ASTM D 2412 "Standard Method of Test for External Loading Properties of Plastic Pipe by Parallel Plate Loading."

C. Each length of pipe and each fitting shall have the following data clearly marked on each piece:

1. Manufacturer's name
2. Pipe size
3. PVC compound used
4. ASTM material specification for the PVC compound used

1.03 SHOP DRAWINGS AND MATERIAL SPECIFICATIONS

Complete shop drawings and material specifications shall be submitted to the Engineer upon receipt of bids.

1.04 STORAGE AND PROTECTION

A. PVC pipe and fittings shall be stored under black plastic cover.

B. All pipe and accessories shall be stored aboveground and fully supported so as not to bend or deflect excessively under its own weight. Height of stacked pipe shall not exceed 4 feet. Bundled pipe shall not be stacked more than two bundles high.

C. Kinked, flattened, buckled, broken, or otherwise defective pipe and fittings shall not be used and shall be removed from the site.

D. Pipe shall be handled using nylon slings. Wire rope slings or chains shall not be used.

1.05 GUARANTEE

The Contractor shall provide a guarantee against defective equipment and workmanship in accordance with the requirements of the section entitled "Guarantees and Warranties" of these Specifications.

1.06 RECORD DRAWINGS

Record drawings shall be prepared on reproducible mylars and given to Cleveland Utilities within thirty (30) calendar days of acceptance by C.U. of the completed project. The data to be included on the record drawings shall include as a minimum the following:

1. All changes and revisions to the original sewer plans;

2. Planview and profile of the sewers and any revisions;

3. Location of all tees or wyes as measured from the nearest downstream manhole;

4. Length of the sewer service line measured from the center of the collector line to the end of the pipe;

5. Approximate depth of the end of each sewer service pipe;

6. Where the sewer service line is not perpendicular to the centerline of the

collector line, a measurement from the downstream manhole must be made to a point located on the collector line that is perpendicular to the end of the sewer service line. The length of the sewer service from this point to the end of the pipe must also be noted;

7. All bench marks used for sewer line design and construction must be shown on both construction and record drawings. Permanent bench marks shall be located adjacent to every third manhole on the project and the description and elevation noted on the construction plans.

Review the drawing entitled "Measurement Examples for Locating Sewer Service Lines" located in the back of these specifications so proper information can be shown on as-built drawings.

PART 2 - PRODUCTS

2.01PVC PIPE AND FITTINGS

A. The pipe and fittings shall be homogeneous throughout and free from visible cracks, holes, foreign inclusions, or other injurious defects. The pipe shall be as uniform as commercially practical in color, opacity, density, and other physical properties.

B. The manufacturer shall provide waterstops, acceptable to the Engineer, which shall be applied to the outside of the plastic pipe when the pipe is to be enclosed in any structure where concrete or mortar is used which will prevent leakage along the outer wall of the barrel of the pipe.

C. No single piece of pipe shall be laid on any project covered by this Specification unless it is found to be generally straight. Such pipe shall have a maximum ordinate as measured from the concave side of the pipe not to exceed 1/16 inch per foot of length. If the deviation exceeds this requirement, then the particular piece of pipe shall be rejected from use until it can comply with this provision.

D. Wyes, tees, bends, adapters, and any other fittings required or directed by the Engineer shall be provided. Engineering data for such fittings showing cross-sectional views with dimensions shall be provided and such data and fittings shall be approved by the Engineer prior to their use. The materials used in the manufacture of fittings shall conform to the requirements for the pipe with which they shall be used and any variation of such requirements shall be subject to the approval of the Engineer. Fittings shall have wall thicknesses equal to or greater than that of the pipe to which they are joined.

2.02 PIPE

A. PVC piping and accessories shall be made from Virgin Type I, Grade 1 PVC compounds with physical and chemical properties conforming to those defined and described in ASTM D 1784 for "Rigid Poly (Vinyl Chloride) Compounds and Chlorinated Poly (Vinyl Chloride) Compounds."

B. The standard length of PVC pipe under this Specification shall not exceed 12.5 feet, except that all pipe used in service lines shall not exceed 20 feet in length unless otherwise approved by the Engineer.

C. The PVC pipe and accessories shall be manufactured in accordance with the requirements of ASTM D 3034, Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings. Four-inch-diameter pipe for service lines (house connections and all other diameter pipe for gravity sewers shall have an SDR of 35 or less. The pipe shall be manufactured to the following dimensions: (All dimensions in inches)

Nominal Size	Outside Diameter	SDR Designation	Minimum Wall Thickness
4	4.215	33.5	0.125
6	6.275	35.0	0.180
8	8.400	35.0	0.240
10	10.500	35.0	0.300
12	12.500	35.0	0.360
15	15.300	35.0	0.437

2.03 JOINTS

A. PVC pipe joints shall be the bell and spigot type subject to the approval of the Engineer.

B. Joints shall be sealed with a rubber O-ring gasket, and shall be of a composition and texture which is resistant to common ingredients of sewerage, industrial wastes including oils and ground water, and which will endure permanently under the conditions likely to be imposed by this usage. The gasket installation shall be done in accordance with the pipe manufacturer's instructions using all the necessary materials, lubricants and equipment recommended by the manufacturer.

PART 3 - EXECUTION

3.01 PIPE LAYING

A. Before sewer pipe is placed in position in the trench, the bottom and sides of the trench shall be carefully prepared and bracing and sheeting installed where required. A mason's line, supported at intervals not exceeding 50 feet, shall be stretched tightly above ground level at a grade parallel to and directly above the axis line of the pipe. Each pipe shall be accurately placed to the exact line and grade called for on the Drawings by measuring down from this line to the invert of the pipe in place. The Contractor shall furnish all labor and materials necessary for erecting batter boards and establishing lines and grades therefor.

B. The Contractor may use the laser beam method of setting a line and grade for the sewer by using the laser beam coaxially through the center of the sewer being laid. The laser beam projector is to be rigidly mounted to its support platforms, with a two-point suspension, or equivalent, assuring that all ground and equipment vibrations are kept to an absolute minimum. All equipment including equipment necessary to control atmospheric conditions in the pipe to keep line and grade to acceptable standards of accuracy shall be furnished by the Contractor. The laser beam system must be operated by competent experienced men who have been properly trained to operate the equipment used.

C. The Contractor shall stake check pegs at all manholes throughout the job. Check pegs midway between manholes and any other check points deemed necessary to assure accuracy of the equipment shall be provided by the Contractor.

D. Each piece of pipe and special fitting shall be carefully inspected before it is placed and no defective pipe shall be laidin the trench. Pipe laying shall proceed upgrade, starting at the lower end of the grade and with the bells uphill. No pipe shall be laid except in the presence of an inspector representing the Engineer. Trench bottoms found to be unsuitable for foundations after pipe laying operations have started shall be corrected and brought to exact line and grade with approved compacted materials as provided under the section entitled "Earthwork" of these specifications.

E. Bell holes shall be of sufficient size to allow ample room for making the pipe joints properly. Bell holes shall not be cut out more than ten joints ahead of pipe laying. The bottom of the trench between bell holes shall be carefully graded so that the pipe barrel will rest on a solid foundation for its entire

length as shown on the Drawings. Each joint shall be laid so that it will form a close

concentric joint with adjoining pipe in order to avoid sudden offsets or inequalities in the flow line.

F. Water shall not be allowed to run or stand in the trench while pipe laying is in progress or before the joints are completely set or before the trench has been backfilled. The Contractor at no time shall open up more trench than his available pumping facilities are able to dewater. Where sewer pipelines are located in or across stream beds or drainage ditches, the Contractor shall divert the stream flow and dewater each section as the work progresses.

G. No joints shall be made where pipe or joint materials have been soiled by earth in handling until such soiled surfaces are thoroughly cleaned by wire brushing and wiping until all traces of the earth are removed.

H. As the work progresses, the interior of all pipe shall be kept thoroughly clean. After each line of pipe has been laid, it shall be carefully inspected and all earth, trash, rags, and other foreign matter removed from the interior. A filled bag or other approved type of follower shall be pulled through the line immediately after each joint is made in order to remove any debris which may be left on the inside of the pipe.

I. Backfilling of trenches shall be started immediately after the pipe in place has been inspected and approved by the Engineer and backfill shall be deposited and compacted as provided under the section entitled "Earthwork" of these Specifications.

J. As a general rule, in traveled areas where cover is less than 4 feet, or in open areas where cover is less than 2 1/2 feet ductile iron pipe or concrete encasement shall be used.

K. Installation of service pipe shall conform to the appropriate requirements of main line sewers.

L. Connections of service lines to the main sewer shall be made with bends of the proper degree to make the service run perpendicular to the main sewer. Pipe shall be laid to a uniform line and grade. Minimum grade shall be 1 percent.

M. The end of all service connections shall be plugged with a PVC plug and sealed with plastic joint material.

N. Crushed stone bedding and backfill material, concrete encasement and protection, etc., for service line installation shall be provided as conditions require and as directed by the Engineer.

O. No service connections shall be covered until they have been inspected and located by the Engineer.

P. CHECK DAMS

1. Check dams shall be installed in the bedding and backfill of all new or replaced sewer lines to limit the drainage area subject to the french drain effect of gravel bedding. Dams shall consist of compacted clay bedding and backfill at least three (3) feet thick to the top of the trench and cut into the walls of the trench two (2) feet. Refer to construction detail drawing 200-395.

2. Alternatively , concrete may be used, keyed into the trench walls. Dams shall be placed no more than 500 feet apart. The preferred location is upstream of each manhole. All stream crossings will include check dams on both sides of the crossing.

3.02 INSTALLATION OF TEES, RISERS, AND PLUGGED SERVICE STUBS

A.Tee branches shall be installed in the sewer lines at all places shown on the Drawings, specified herein or otherwise directed by the Engineer. Tee branches on pipe less than 12 inches in diameter shall be cast or extruded and manufactured monolithic with the barrel.

B.Riser connections, of the size and type shown on the Drawings shall be installed at the locations shown on the Drawings or directed by the Engineer. A plastic film marking tape 5-feet long shall be placed 12 inches over the top of each riser during backfilling to mark the location of the riser. The marking tape shall be heavy gauge polyethylene film (.004 inch thick). Tape shall be standard red color imprinted with the words "Warning - Buried Sewer Line Below." Tape shall be Allen Marking Tape No. AMT-1212 as manufactured by the Allen System, Inc., Glen Ellyn, Illinois, or equal. A second marking tape containing a metallic core which shall be located with a metal detector shall be laid on top of the first marking tape. This tape shall be 5 feet long and 2 inches wide. The tape shall be Allen Detectotape Catalogue No. ADT-1003 for buried sewer line as manufactured by the Allen System, Inc., or equal. An additional piece of approved metallic detection tape shall be tied to the end of the riser pipe and brought vertically to finished grade as backfilling progresses.

C. All sewer service stubs shall have a length of Allen Detectotape, Catalogue No. ADT-1003, attached to the end of the service stub and extend vertically to the surface of the ground.

D. Plugged pipe stubs for future connections to manholes and sewerage structures shall be installed where shown on the Drawings or directed by the

Engineer. The pipe stubs shall be installed with the bell encased in the wall of the manhole and the bell opening flush with the outside wall of the manhole or structure.

E. Plugged stubs and such branches of pipelines that are not to be used immediately shall be closed with PVC stoppers held securely in place.

F. Where specifically directed by the Engineer or shown on the Drawings, connections to reinforced concrete pipe over 18 inches in diameter shall be made in accordance with details shown on the Drawings.

3.03 CONNECTIONS

A. If the work consists of the construction of a sewer that is to replace an existing sewer, all of the existing service lines shall be kept in operation and connected to the new line. Reconnections shall be made with flexible rubber couplings,i.e. Fernco or equal, and approved by C.U. Detection tape equal to Allen Detectotape Catalogue # ADT-1003 as manufactured by Allen System, Inc. or approved equal, shall be tied around the existing service line at the point of reconnection and then brought straight up to the finished ground surface.

B. Connections shall be made to all existing sewer lines in the vicinity of the work by removing a section of the sewer from the existing line and inserting in the space a tee branch of proper size, or by the construction of a manhole, regulator chamber or other structure as shown on the Drawings.

C. Connections to existing manholes or inlets where no plugged stubs exist shall be made by cutting a hole in the wall of the existing structure, inserting a length of sewer pipe into the hole, filling around same with concrete or mortar and troweling the inside and outside surfaces of the joint to a neat finish. All sewer pipe shall have a rubber waterstop (concrete manhole adapter), i.e. Fernco, or approved equal approved by C.U. It shall be installed and embedded in the cement mortar patch. The bottom of the manhole shall be shaped to fit the invert of the sewer pipe as specified under the section entitled "Manholes" of these Specifications.

D. Connections to building services shall be made in a neat and workmanlike manner. Cleanout plugs shall be installed, when directed by C.U., by making the connections with a standard wye or tee.

3.04 EXISTING UTILITIES

A. All existing sewers, water lines, gas lines, underground conduits, telephone lines, sidewalks, curbs, gutters, pavements, electric lines, or other utilities or structures in the vicinity of the work shall be carefully protected by the Contractor from damage at all times. No separate payment shall be made for removing and replacing and/or repairing damaged existing sewers; water, gas, electric, telephone lines or conduits; or other utilities, culverts, drains, or conduits of similar existing services or structures. Similar repair and replacement of sidewalks, curbs, gutters, and pavements are provided elsewhere in these Specifications.

B. Sewers to be installed parallel to any existing or proposed water main shall be laid at least 10 feet, horizontally, from the water main. If conditions prevent the 10-foot separation, the sewer may be constructed closer to a water main if it is laid in a separate trench and if the bottom of the water main is at least 18 inches above the top of the sewer.

C. When sewers cross under water mains, the top of the sewer shall be at least 18 inches below the bottom of the water main. If necessary, the water main shall be relocated to provide this separation or reconstructed with mechanical-joint ductile iron pipe for a distance of 10 feet on each side of the sewer. One full length of water main shall be centered over the sewer so that both joints will be as far from the sewer as possible.

D. When it is impossible to obtain proper horizontal and vertical separation as stipulated above, both water main and sewer shall be constructed of mechanical-joint ductile iron pipe and shall be pressure tested to assure water tightness.

E. When sewer lines cross under culverts where the sewer and the culvert are less than 18 inches apart, the sewer line shall be encased in concrete as shown on the Standard Drawings.

3.05 INSPECTION AND TESTING

A. After completion of any section of sewer, the grades, joints, and alignment shall be true to line and grade. Joint surfaces shall be smooth. There shall be no visual leakage and the sewer shall be completely free from any cracks and from protruding joint materials, deposits of sand, mortar, or other materials on the inside.

B. One hundred percent of all PVC pipe 8 inches in diameter and greater shall be deflection tested. The maximum allowable deflection for PVC is 5 percent.

After the PVC pipe has been installed and backfilled, the Contractor shall check the deflection by pulling a rigid ball or an Engineer approved 9-arm mandrel sized at 95 percent of the actual inside diameter of the pipe used through the pipe. "Flexible pipe is considered to have reached the limit of service ability when a deflection of 5% is attained" (WPCF MOP # 9, p. 222). Since research indicates that trench loads can increase for periods in excess of 10 years to loads almost twice the original load, a safety factor of 2 is recommended. The appropriate allowable deflection when installed (must be less than 5%) may be calculated using the pipe stiffness formula in ASTM

D2321. Deflection tests shall not be conducted before the elapse of 24 hours after backfilling. Any pipe not passing the mandrel shall be replaced and rechecked.

C. Infiltration shall not exceed 25 gallons per 24 hours per inch of diameter per mile of sewer. Contractor shall furnish all supplies, materials, labor, services etc., needed to make infiltration or exfiltration tests including water. No separate payment will be made for equipment, supplies, material, water, or services.

D. Any leakage, including active seepage, shall be corrected by removal and replacement of pipe or joint where such leakage exists until the pipelines meet the requirements of the allowable leakage specifications.

E. All sewer pipe shall be tested using low pressure air testing in accordance with the procedures and standards listed below:

1. Clean pipe to be tested by propelling snug-fitting inflated rubber ball through pipe with water.

2. Plug all pipe outlets with suitable test plugs. Brace each plug securely to prevent blowouts. As a safety precaution, pressurizing equipment shall include a regulator set at slightly above test pressure to avoid overpressurizing and damaging an otherwise acceptable line. No one shall be allowed in the manhole during testing.

3. During manhole fabrication, a 1/2-inch diameter threaded pipe nipple shall be cast through the manhole wall directly on top of one of the sewer pipes entering the manhole. The threaded end of the nipple shall extend no more than two inches on the inside of the manhole. The total length of the nipple shall exceed the manhole wall thickness by no less than four inches. The pipe nipple shall be non-corrosive and resistant to chemicals common to domestic sewage. Special attention shall be given to providing a permanent, watertight seal around the pipe nipple at the manhole wall. The pipe nipple shall be sealed with a threaded 1/2-inch cap or plug. Every manhole need not have a pipe nipple, but 20 percent of all manholes on each line shall have an installed

nipple. The Engineer shall assist the Contractor in selecting appropriate locations for manholes with pipe nipples installed.

4. Add air slowly to the portion of the pipe installation under test until the internal air pressure is raised to 4.0 psig greater than the average back pressure of any groundwater above the pipe (0.433 psi per foot of groundwater above the pipe invert), but not greater than 9.0 psig.

5. After an internal pressure of 4.0 psig is obtained, allow at least two minutes for air temperature to stabilize, adding only the amount of air required to maintain pressure.

6. When pressure decreases to 3.5 psig, start stopwatch. Determine the time in seconds that is required for the internal air pressure to reach 3.0 psig. Minimum permissible pressure holding times for runs of single pipe diameter are indicated in the table in seconds. No separate allowance shall be given for laterals.

SPECIFICATION TIME REQUIRED FOR A
0.5 PSIG PRESSURE DROP
FOR SIZE AND LENGTH OF PIPE INDICATED

Pipe Dia. (in.)	Min. Time (min. sec.)	Length for Min. Time (ft.)	Time for Longer Length (sec.)	Specification Time for Length (L) Shown (Min:sec) 100 feet	200 feet	300 feet	350 feet	400 feet
8	3:47	298		3:47	3:47	3:48	4:26	
10	4:43	239		4:43	4:43	5:56	6:55	
12	5:40	199		5:40	5:42	8:33	9:58	
15	7:05	159		7:05	8:54	13:21	15:35	
18	8:30	133		8:30	12:49	19:14	22:26	25:38
21	9:55	114		9:55	17:27	26:11	30:32	34:54
24	11:20	99	6.837xL	11:24	22:48	34:11	39:53	45:35
27	12:45	88	8.653xL	14:25	28:51	43:16	50:30	57:42
30	14:10	80	10.683xL	17:48	35:37	53:25	62:19	71:13
33	15:35	72	12.926xL	21:33	43:56	64:38	75:24	86:10
36	17:00	66	15.384xL	25:39	51:17	76:55	89:44	102:34

F. The sewer lines installed as part of the work governed by these specifications will be subject to television inspection by Cleveland Utilities. This work will be

provided by C.U. at no charge to the contractor/developer according to the following terms:

1. Initial television inspection

2. Second return television inspection will be to verify that the initial defects have been corrected.

3. Thereafter the contractor/developer will be billed on a cost-plus-15% basis for manpower and equipment required to verify correction of installation defects.

3.06 CLEANUP

After completing each section of the sewer line, the Contractor shall remove all debris, construction materials, and equipment from the site of the work, grade and smooth over the surface on both sides of the line and leave the entire right-of-way in a clean and neat condition. Unless otherwise called for on the Drawings, the Contractor shall restore all disturbed areas to as close to its original condition as possible. Restoration shall include but not be limited to grassing, replacing shrubbery, trees, fences and other improvements which have been disturbed.

Cleanup and restoration shall be completed as soon as possible and shall not exceed (30) calendar days after each section of sewer line is installed. Should the Contractor fail to do the cleanup as soon as possible or within 30 calendar days, payment made for pipe sewers and service lines for that section of the sewer not cleaned up shall be removed from the periodic estimate until the cleanup work is completed.

** END OF SECTION **