

SECTION D1

SEWER AND DRAIN PIPE

GENERAL

This section covers the replacement of existing sewers and drains, the installation of new sewers and drains and the separation of existing combined sewers by the laying of new sewer and drain lines.

MATERIALS

Pipe materials shall be reinforced concrete pipe; polyvinylchloride pipe (PVC) or ductile iron pipe as noted on the plans. All pipe greater than 21" shall be reinforced concrete or ductile iron unless noted on the plans. Where noted, PVC pipe greater than 21" shall be closed profile pipe or special designation large diameter PVC as described in these specifications. HDPE pipe shall only be used where noted on the plans or where directed by the Engineer.

Reinforced Concrete Pipe

Reinforced concrete pipe shall be manufactured in a plant adapted to meet the design requirements of the pipe.

Each unit of pipe shall have an interior surface that is free from roughness, projections, indentations, offsets, or irregularities of any kind. The pipe units shall be Class IV unless otherwise indicated on the drawings and shall conform to ASTM Standard Specifications for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe, Designation C76 latest version, with the following exceptions and additions:

- A. Elliptical reinforcement will not be permitted.
- B. Average absorption as determined by the ASTM C76 method shall not exceed 6 percent, with no specimen over 6.3 percent.
- C. Pipe units shall have a minimum laying length of 8 feet, except as otherwise indicated or permitted by the Engineer.
- D. Pipe units shall be cured as required by ASTM C76.

E. There shall be no lift holes in the pipe sizes up to and including 36-inch diameter.

F. The date of manufacture, class of pipe unit, size of pipe unit, and trademark of the manufacturer shall be clearly and permanently marked on the outside at one end of each pipe unit.

G. Coatings on RCP

The interior surface of all reinforced concrete pipes for sanitary or combined sewers shall receive a protective coating of an approved epoxy resin compound at the plant where the pipe is manufactured prior to delivery to the site of the work.

The coating material shall be a non-toxic resin for use specifically for the interior of concrete pipes and applied by the manufacturer. The contractor shall submit the information regarding the coating to the Commission for review and approval.

The protective coating shall be applied in accordance with the manufacturer's recommendations. In doing this work, the coating manufacturer's instructions for the best application procedures, temperatures and allowable working life of the material shall be strictly adhered to. Any deficiency in total film thickness shall be corrected by the application of an additional protective coat. If a prime coat is necessary, it shall be as per the manufacturer's specifications. A prime epoxy coat shall not be applied on a smooth concrete pipe. Before placement in field, all areas abraded in transit shall be repaired by the application of 2 coats of the same material that was used in the shop, in accordance with the directions of the coating manufacturer.

The protective coating shall be applied in accordance with the manufacturer's recommendations and specifications.

J. Branches on RCP

Where specified, provision shall be made for the connection of 6-inch diameter PVC building connections.

During manufacture of 6-inch diameter PVC, bells shall be cast integrally with the pipe. The pipe end of the PVC bell shall be trimmed flush with the interior of the main line pipe. The

bell shall be installed at 45° to the main line pipe or at any angle as specified. A suitable PVC plug shall be installed in the bell thereby preventing the ingress of any backfill or other material to the system until the lateral is connected and placed in service. PVC bells and plugs shall conform to ASTM D3034, Standard Specification for Type PSM polyvinylchloride sewer pipe and fittings.

K. Joints on RCP

Pipe joints for all reinforced concrete pipes shall be of the rubber gasket type in which the gaskets are in compression and which will permit both longitudinal and angular movement. Each unit of pipe shall be provided with proper ends made of concrete formed true to size and formed on machined rings to ensure accurate joint surfaces. Joints and gaskets for pipe 36 inches or less in diameter shall be the O-ring gasket type and shall conform to the requirements of ASTM Standard Specifications for Reinforced Concrete Low-Head Pressure Pipe, Designation C361, latest version and the additional requirements specified. Joints and gaskets for pipe larger than 36 inches in diameter shall be O-ring or ribbed gasket type and shall conform to the requirements of ASTM Standard Specifications for joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets, Designation C443, latest version and the additional requirements specified.

Joints shall be of such design that when tested under an average internal hydrostatic pressure of 10 p.s.i. no visible leakage will result.

Gaskets shall be of a composition and texture which is resistant to common ingredients of sewage, industrial wastes, and groundwater, and which will endure permanently under the conditions likely to be imposed by this service. Gaskets shall be the product of a manufacturer regularly engaged in the manufacture of rubber gaskets for pipe joints.

After the pipe joints have been made and the interior surface properly prepared, the joints and adjacent areas and any damaged portion of the previously applied protective coating shall be brought to a continuous surface of coating by means of at least 2 brush coats of epoxy compound. The thickness of brush coats shall be equivalent to those previously applied by spray. In 24-inch pipe, the Contractor may, if he so elects, incorporate the epoxy compound with the non-shrinking grout prior to filling the pipe joint with the grout rather than

epoxy coating the joint after the joint has been grouted. Exterior joints are not to be filled or treated unless directed by the Engineer.

L. Inspection and Acceptance

Acceptance will be upon testing that shall include external pipe load testing, concrete compressive strength, hydrostatic testing of pipe and hydrostatic testing of rubber gasket joints in accordance with ASTM C497. Inspection may be made at the place of manufacture, or on the work after delivery, or both, and the pipe shall be subject to rejection at any time due to failure to meet any of the specification requirements, even though sample pipe units may have been accepted as satisfactory at the place of manufacture. The Contractor shall immediately remove all pipe which is rejected from the project site.

Tests and certified copies in triplicate of test results will be required for the materials as described herein. If less than 100 units of a given size and class of pipe are required, the Contractor may submit certified copies of tests made on identical pipe units made by the same manufacturer within the past year. If more than 100 units of a given size and class of pipe are required, the Contractor shall, at his own expense, engage the services of an acceptable independent testing laboratory to perform or witness all tests, other than mill tests on reinforcing steel and cement, and certify the results. In addition, the Commission reserves the right to have any or all pipe units inspected or tested, or both, by an independent testing laboratory at either the manufacturer's plant or elsewhere. Such additional inspection and/or tests shall be the test results of record. Should the test results be satisfactory, the cost for the tests shall be at the Commission's expense. Should the test results not be satisfactory, the cost for the tests shall be at the Contractor's expense.

All tests shall be made in accordance with the above-mentioned applicable ASTM specifications, and acceptance or rejection shall be based on the test results.

Where required for more than 100 units, concrete cylinder compression tests shall be made on standard concrete cylinders for the first or test pipe unit and then for every 100 cubic yard of concrete used in pipe manufacture, or for each additional 200 units of pipe, whichever represents the lesser

amount of concrete. Four cylinders shall be made for each test, and they shall be broken at 7, 14, and 28 days with one cylinder as a spare to be used in the event of an unsatisfactory break. The reports shall be submitted within three days after each of the compression tests.

M. Field Connection to RCP

Where lateral pipes are to be connected to RCP at random locations as determined by field conditions (i.e. buildings laterals whose exact locations are unknown until determined by excavation) a suitable opening shall be made in the wall of the R.C.P. by the use of a portable concrete coring machine. Under no circumstances will the contractor be allowed to form an opening by any other means such as drilling, chipping or the use of pneumatic hammers.

For main pipe sizes up to 24 inches in diameter laterals shall be connected using either flexible or cast iron saddles. Saddles shall be attached to the pipe using stainless steel bands.

For main pipe sizes greater than 24 inches in diameter, laterals shall be connected by saddles or resilient connectors with internal expansion rings. Resilient connectors shall conform to ASTM C923-89, Standard Specification for Resilient Connections between Reinforced Concrete Manhole Structures, Pipes and Laterals.

In no case shall laterals be rigidly attached to the main line or allowed to protrude into the main line.

Polyvinylchloride Pipe

Solid wall polyvinylchloride pipe, (PVC) sizes 4" to 15" and fittings shall conform to ASTM Standard Specification for type PSM (PVC) sewer pipe and fittings, designation D3034, latest version. Coextruded PVC pipe and fittings using recycled materials and conforming to ASTM Standard Specification, designation F1760, latest version, may also be used. All pipe shall have a minimum pipe diameter to wall thickness ratio (SDR) of 35 and a minimum pipe stiffness of 46 psi.

Solid wall polyvinylchloride pipe sizes 18" to 36" and fittings shall conform to ASTM Standard Specification for large diameter

PVC pipe, designation F-679, latest version. The pipe shall have an SDR ratio of 35 and a pipe stiffness of 46 psi.

Wye branches shall conform to the specifications referenced above for pipe material. Saddle wye branches are prohibited.

Pipe and fittings shall have bell and spigot (push-on) joints using elastomeric ring gaskets. Gaskets shall be made of a composition and texture, which is resistant to common ingredients of sewage and industrial wastes, including, oils and ground water and which will endure permanently under the conditions of its proposed use.

Joints shall conform to ASTM Standard Specifications of Joints for Drain and Sewer Plastic Pipe using Flexible Elastomeric Seals, Designation D3212, latest version.

All pipe and fittings delivered to the job site shall be accompanied by test reports certifying that the pipe and fittings conform to the above mentioned ASTM specifications.

The Contractor shall furnish all labor necessary to assist the Engineer in inspecting the pipe and fittings. The pipe and fittings shall be inspected upon delivery and any which does not conform to the above specifications shall be rejected and immediately removed from the site by the Contractor.

PVC Closed Profile Pipe

PVC Closed Profile pipe and fittings, sizes 24" to 48" shall conform to all standards of ASTM F1803. PVC shall meet the standards of ASTM-D1784, Classification 12364A for material and a pipe stiffness of 46 psi when tested in accordance with ASTM-D2412. All pipe joints shall be bell and spigot push-on joint with elastomeric seals in accordance with ASTM-D3212. Gaskets shall be factory installed and chemically bonded to the bell end of the pipe and the material shall be in accordance with ASTM-F477.

Wye branch shall conform to the Specifications referenced above for pipe material, joints and gaskets. All other type connections including saddle connections and insert type connections shall be submitted for review and approval.

All pipe and fittings delivered to the job site shall be accompanied by test reports certifying that the pipe and

fittings conform to the above mentioned ASTM specifications. Fabricated mitered joints shall be reinforced by fusion heat welding. All piping shall be adequately supported in accordance with the contract plans and as specified herein.

The Contractor shall furnish all labor necessary to assist the Engineer in inspecting the pipe and fittings. The pipe and fittings shall be inspected upon delivery and any which does not conform to the above specifications shall be rejected and immediately removed from the site by the Contractor.

Installation shall be in accordance with ASTM D2321.

Groundwater Recharge Pipe (Perforated PVC Pipe)

Pipe shall be perforated SDR 35 PSM Gravity Sewer Pipe meeting the requirements of ASTM D-3034, ASTM D-1784, ASTM F- 477, ASTM D 3212 if gasketed joints.

Perforation Arrangement:

Hole size: 7/8" +/- 1/16"

Center to center: 6" +/- 1/4"

Row of Holes: 2, 120 degrees +/- 5 degrees

Pipe to be installed with holes down.

High Density Polyethylene Pipe (HDPE)

Materials used for the manufacture of polyethylene pipe and fittings shall be made from a PE 3408 high density polyethylene resin compound meeting cell classification 345434C per ASTM D3350; and meeting type 111, Class C, Category 5, Grade P34 per ASTM D1238.

Dimensions and workmanship shall be as specified by ASTM F714. HDPE fittings and transitions shall meet ASTM D3261. HDPE pipe shall have a minimum density of 0.955 grams per cubic centimeter. All HDPE pipe and fittings shall have a Hydrostatic Design Basis (HDB) OF 1,600 psi.

The pipe shall be joined with butt, heat fusion joints as outlined in ASTM D2657 and conform to the Generic Butt Fusion Joining Procedure for Field Joining of Polyethylene Pipe, Technical Report TR -33/2005, published by the Plastic Pipe Institute (PPI). All joints shall be made in strict compliance with the manufacturer's recommendations. A factory qualified joining technician as designated by pipe manufacturer or

experienced, trained technician shall perform all heat fusion joints in the presence of the FPUA inspector.

Wye branches shall conform to the Specifications referenced above for pipe material, joints and gaskets. All other type connections, including saddle connections and insert type connections shall be submitted to the Engineer for review and approval.

All pipe and fittings delivered to the job site shall be accompanied by test reports certifying that the pipe and fittings conform to the above mentioned specifications. Fabricated mitered joints shall be reinforced by fusion heat welding. All piping shall be adequately supported in accordance with the contract plans and as specified herein.

The Contractor shall furnish all labor necessary to assist the Engineer in inspecting the pipe and fittings. The pipe and fittings shall be inspected upon delivery and any which does not conform to the above specifications shall be rejected and immediately removed from the site by the Contractor.

Installation shall be in accordance with ASTM D2321, latest version.

Ductile Iron Pipe

Ductile iron pipe shall be designed in accordance with ANS21.AWWA C150 and manufactured in accordance with ANS A21.51/AWWA C151.

Ductile iron pipe shall be Class 56.

Pipes shall be lined on the interior with a coating specifically designed to carry sewerage as per ASTM A746.

All pipe shall be push-on joint conforming to ANS A21.11/AWWA C111. Push-on joints shall be provided with sufficient quantities of accessories conforming to ANS A21.11/AWWA C111.

Push-on joints shall be made up by first inserting the gasket into the groove of the bell and applying a thin film of non-toxic gasket lubricant uniformly over the inner surface. The chamfered end of the plain pipe shall be inserted into the gasket and forced past it until it seats against the bottom of the socket.

A. Fittings for Ductile Iron Pipe

The Contractor shall furnish and install all the required fittings shown on the plans or as directed by the Engineer. All fittings shall be ASTM A-536 ductile iron, lined as per the accepted sewer pipe and mechanical joint. All fittings 4-inch through 16-inch in diameter shall meet or exceed the requirements of AWWA C-110 or AWWA C-153. Fittings greater than 16 inches in diameter shall meet or exceed AWWA C-110 only.

All fittings shall be Class 350 and shall conform with the weights, excluding accessories, and dimensions shown in the latest edition of the Handbook of Ductile Iron Pipe and come complete with all joint accessories where required. All fittings shall be lined as per the accepted sewer pipe. All accessories (gland, gaskets, T-bolts and nuts) shall be in accordance with AWWA C-111. Gaskets used for installations in close proximity to steam lines (as identified on the contract drawings or determined by the Engineer) shall be heat resistant, EPDM type or equivalent. All mechanical joint bolts (T-bolts) shall be Cor-Ten or equal.

B. Sleeve Couplings for Ductile Iron Pipe

Sleeve couplings and accessories shall be pressure rated at least equal to that of the pipe. Couplings shall be cast iron and shall be Dresser Style 53 or 153, or acceptable equivalent product. The couplings shall be provided with "Cor-Ten" bolts and nuts or approved equal.

After assembly, all exterior surfaces including the bolts and nuts shall be thoroughly coated with two coats of heavy-duty protective coating. The interior of the coupling shall be epoxy-coated in accordance with Section C7 contained herein.

Minor Drain

Pipes used to connect sewer and drain services laterals are minor drain. Sizes are required to match existing services.

All catch basin laterals having less than three and a half feet of cover anywhere in the run shall be Ductile Iron or Reinforced Concrete pipe. Catch basin laterals shall be 12 inches in diameter, except for connections to combined sewers, which may be 10 inches in diameter to meet existing trapped connections.

Drop Inlet pipes shall be 16-inch Ductile Iron or 15-inch Reinforced Concrete pipe.

Filter Fabric

Filter fabric shall be installed where indicated on the trench details and shall be polyester, polyvinylidene chloride or polyamid fibers, either woven or non-woven. Filter fabric shall meet the following minimum requirements:

1. Puncture strength - 25 pounds.
2. Bursting strength - 130 psi.
3. Permeability - .010 cm/sec.
4. Flow rate - 40 gallons per minute per square foot at four inches of head.
5. Sewn strength - 70 pounds
6. Grab strength - 80 pounds
7. Trapezoidal tear - 25 pounds

Apparent opening size shall be no greater than No. 40 U.S. standard sieve.

The drainage filter fabric shall be placed in the manner and at the locations shown in the Contract Drawings. Sharp objects shall be removed from the area before placing fabric to avoid fabric punctures. The fabric shall not be laid in a stretched condition, but laid loosely. The panels shall be overlapped by a length of three feet. Filter fabric damaged or displaced before or during placement of overlying layers shall be replaced or repaired at no additional expense to the owner.

Sewer Couplings

Sewer Couplings shall be pressure rated at least equal to that of the pipe. The coupling sleeve, shall be 1/4-inch minimum thickness elastomeric polyvinylchloride with a minimum tensile strength of 1500 psi. The sleeve shall fit snugly onto the pipe to be joined and be resistant to common chemicals present in sewerage and storm water. Adjustable pipe clamps shall consist of a slotted band that mates with the worm gear screw and a screw housing all manufactured of stainless steel, and suitable for underground service.

CONSTRUCTION METHODS

Storage, Handling and Placing Reinforced Concrete Pipe, Polyvinylchloride Pipe and Closed Profile Polyvinylchloride Pipe

All pipe shall be stored at the site until installation in a manner acceptable to the Engineer which will keep the pipe at ambient outdoor temperatures. Temporary shading shall be provided as required to meet this requirement. Simply covering the pipe or structures which allows temperature build-up when exposed to direct sunlight will not be permitted.

Each pipe unit shall be handled into its position in the trench only in such manner, and by such means as acceptable to the Engineer. Care shall be taken to avoid damaging the pipe and fittings.

Sewer and drain pipe shall be laid at the lines and grades as shown on the plans and specified herein. Whenever encountered within the trench, existing sewer/drain lines shall be removed unless otherwise noted. All existing sewer/drain lines, which are to be abandoned in place, shall be plugged at all open ends.

Each pipe and/or fitting to be installed shall be subjected to a careful inspection just prior to installation. Each straight length of pipe shall be generally straight. Centerline deviation of more than 1/16 inch per foot of length shall be deemed unacceptable and such pipe shall immediately be removed from the site.

RCP, PVC and Closed Profile PVC Pipe shall be supported by compacted-screened gravel (as per Section A3). No pipe or fitting units shall be supported on saddles, blocking or stones. Suitable bell holes shall be provided so that after installation only the barrel of the pipe receives bearing pressure from the supporting material.

All pipe and fittings shall be cleaned of all debris, dirt or other foreign substances prior to being installed and shall be kept clean until accepted.

Before any joint is made, the previously installed unit shall be checked to insure that a closed joint with the adjoining unit has been maintained and that the inverts are matched and conform

to the required grade. Pipe shall not be driven down to the required grade by striking with an unyielding object.

Immediately before joining the pipe all joint surfaces shall be cleaned and the bell or groove shall be lubricated in accordance with the manufacturer's recommendations. Each pipe unit shall be pushed into place without damage to the pipe or gasket.

All open ends of pipe and branches shall be closed with stoppers secured in place in an acceptable manner.

After each pipe has been properly bedded, enough screened gravel or crushed stone shall be placed between the pipe and the sides of the trench, and thoroughly compacted, to hold the pipe in correct alignment. Bell holes shall be filled with screened gravel and compacted, and then screened gravel shall be placed and compacted to complete the pipe bedding as indicated on the drawings.

The Contractor shall take all necessary precautions to prevent flotation of the pipe in the trench.

At all times when the pipe installation is not in progress, the open ends of the pipe shall be closed with temporary watertight plugs, or by other acceptable means.

If water is in the trench when work is to be resumed, the plug shall not be removed until suitable provisions have been made to prevent water, earth, or other substances from entering the pipe.

Pipelines shall not be used as conductors for trench drainage during construction.

All manhole connections shall be as shown on the drawings except that concrete and mortared connections shall be equipped within integral O-ring or other sealant such that a positive watertight seal is established.

Allowable PVC Pipe Deflection

Pipe provided under this specification shall be so installed as to not exceed a maximum deflection of 4.0 percent. Such deflection shall be computed by multiplying the amount of deflection (nominal diameter less minimum diameter when measured) by 100 and dividing by the nominal diameter of the pipe.

Upon completion of a section of sewer, including placement and compaction of backfill, the Contractor shall measure the amount of deflection by pulling a specially designed gage assembly through the completed section. The gage assembly shall be in accordance with the recommendations of the pipe manufacturer and be acceptable to the Engineer.

Should the installed pipe fail to meet this requirement, the Contractor shall do all work to correct the problem as the Engineer may require without additional compensation.

Storage, Handling and Placing Ductile Iron Pipe

Ductile iron pipe shall be laid at the lines and grades as shown on the plans and specified herein. Whenever encountered within the trench existing sewer/drain shall be removed unless otherwise noted. All existing sewer/drain lines, which are to be abandoned in place, shall be plugged at all open ends.

Pipes and fittings shall be subjected to a careful inspection and a hammer (ringing) test just before installation.

Any fitting showing a crack or any fitting or pipe which has received a severe blow that may have caused an incipient fracture, even though no such fracture can be seen, or any fittings or pipe discovered to be defective, shall be marked as rejected and removed at once from the work. Pipe showing a crack shall be removed from the site. Cut ends used with push-on joints shall be chamfered to prevent cutting the gasket when the pipe is laid.

Each pipe shall be cleared of all excess tar, debris, dirt, etc., before laying.

Care shall be taken in loading, transporting, and unloading to prevent injury to the pipes or coatings. Pipe or fittings shall not be dropped. All pipe or fittings shall be examined before laying, and no piece shall be installed which is found to be defective. Any damage to the pipe coatings shall be repaired as directed by the Engineer.

If any defective pipe is discovered after it has been laid, it shall be removed and replaced with a sound pipe in satisfactory manner by the Contractor at his own expense. All pipe and fittings shall be thoroughly cleaned before laying, shall be

kept clean until used in the work, and when laid shall conform to the lines and grades required.

Ductile iron pipe and fittings shall be installed in accordance with the requirements of AWWA Standard Specification C600, except as otherwise provided herein. A firm, even bearing throughout the length of the pipe shall be constructed by tamping selected material at the sides of the pipe, up to the spring line. BLOCKING WILL NOT BE PERMITTED.

When laying is not in progress, including lunchtime; the open ends of the pipe shall be closed by watertight plug or other approved means. The Contractor shall keep the trench free from water while the pipe is being installed. Fittings, in addition to those shown on the plans, shall be provided, if required, in crossing utilities, which may be encountered when opening the trench.

When cutting pipe is required, the cutting shall be done by machine leaving a smooth cut at right angles to the axis of the pipe. Cut ends of pipe shall be beveled to conform to the manufactured spigot end. Repair and damaged lining in accordance with lining manufacturer's recommendations.

Fittings and plugs shall be restrained against hydraulic thrust with a block of Class B concrete conforming to the size and shape required by the Boston Water and Sewer Commission specifications. Yokes and tie rods, retainer glands or any combination thereof shall also be used as directed by the Engineer based on actual field conditions encountered. Unless otherwise approved by the Engineer, all pipe up to and including 12 inch pipe shall have at least two (2) 3/4 inch tie rods, 16-inch pipe at least four (4) 3/4 inch tie rods, and 48-inch pipe at least six (6) 1-1/2 inch tie rods. All yokes and tie rods shall be coated with an approved bituminous paint after assembly.

Deflection Along Ductile Iron Pipe

In laying a full 18-foot length of ductile iron pipe along a curve, the maximum changes in alignment of each length of pipe shall not exceed the following amounts:

Maximum Permissible Deflection

Size of Pipe (Inches)	Push-On- Joint (Inches)	Mechanical Joint (Inches)
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4	19	31
6	19	27
8-12	19	20
16	11	13-1/2
18-20	11	11
24-30	11	9

Cleaning

Care shall be taken to prevent earth, water, and other materials from entering the pipeline. As soon as possible after the pipe and manholes are completed, the Contractor shall clean out the pipeline and manholes, being careful to prevent soil, water, and debris from entering any existing sewer.

Service Connections

Service connections shall be installed at a minimum slope of 2 percent at the locations determined by the Engineer in the field.

It should be anticipated that each building along the sewer or drain being installed will have one sewer connection and one drain connection. Also, wye connections for future construction may be required.

Services may be connected to new PVC, Ductile Iron or HDPE pipe using solid wye connections, approved saddles or flexible connectors. Solid wye connections shall be the same material as the main pipe. Saddles shall be a full PVC or iron saddle with rubber gaskets and tightened with stainless steel straps. Saddles cemented onto the pipe are not acceptable. Resilient connectors shall be either tees or wyes as required by the plans or approved by the Engineer. Both shall make a watertight connection to the host pipe through a gasketed connection and connect to the service lateral using a stainless steel clamp. The use of saddles or flexible connectors require that an opening be made in the pipe with a coring machine and appropriate cutting tool for the type of pipe to be cored. When installing a flexible wye the contractor shall use the coring guide supplied by the manufacturer of the wye connector.

The Contractor shall reconnect all service connections except those eliminated by approval of the Engineer. Any pipe necessary to make the reconnection from the existing lateral to the new pipe shall be considered Minor Drain.

Each wye or Tee branch installed for future use shall be fitted with a watertight plug.

Chimneys shall be installed when directed by the Engineer. Such chimneys shall be constructed in accordance with the details on the drawings or with the Standard Details of the Boston Water and Sewer Commission for Sewer Chimneys.

Sewer Coupling Installation

Sewer couplings which are factory manufactured shall be installed at all connections from existing pipe to proposed pipe unless the existing pipe is the same material as the proposed pipe and the bell and spigot end of the pipes to be connected are compatible and free from defects. All sewer couplings shall be installed in accordance with the manufacturer's recommendations for the types of pipe to be connected.

Leakage Testing

Leakage tests and measurements shall be made for all manhole-to-manhole sections in which no service laterals are connected.

Where the groundwater level is more than 1 foot above the top of the pipe at its upper end, the Contractor shall conduct either infiltration tests or joint testing per ASTM C1103.

Where the groundwater level is less than 1 foot above the top of the pipe at its upper end, the Contractor shall conduct either exfiltration tests or joint testing per ASTM C1103.

At the time of the test, the Contractor shall determine the groundwater elevation from observation wells, excavations or other means, all subject to the acceptance of the Engineer.

For making the infiltration and exfiltration tests, the Contractor shall furnish suitable test plugs, water pumps, and appurtenances, and all labor required to properly conduct the tests on sections as directed.

Upon completion of a section of the sewer, the Contractor shall dewater it and conduct a satisfactory test to measure the infiltration for at least 24 hours. The amount of infiltration, including manholes, tees, and connections, shall not exceed 200 gallons per inch diameter per mile of sewer per 24 hours for RCP

and 50 gallons per inch diameter per mile of pipe per 24 hours for PVC and ductile iron pipe.

For making the exfiltration tests, the sewers shall be subjected to an internal pressure by plugging the pipe at the lower end and then filling the pipelines and manholes with clean water to a height of 2 feet above the top of the sewer at its upper end. Where conditions between manholes may result in test pressures, which would cause leakage at the stoppers in branches, provisions shall be made by suitable ties, braces, and wedges to secure the stoppers against leakage resulting from the test pressures.

The rate of leakage from the sewers shall be determined by measuring the amount of water required to maintain the level 2 feet above the top of the pipe.

Leakage from the sewers under test shall not exceed the requirements for leakage into sewers as hereinbefore specified.

The sewers shall be tested before any connections are made to buildings.

The Contractor shall construct weirs or other means of measurements as may be required.

Suitable bulkheads shall be installed, as required, to permit the test of the sewer.

Should the sections under test fail to meet the requirements, the Contractor shall do all work of locating and repairing the leaks and retesting as the Engineer may require without additional compensation.

If in the judgment of the Engineer, it is impracticable to follow the foregoing procedures for any reason, modifications in the procedures shall be made as required and as acceptable to the Engineer, but in any event, the Contractor shall be responsible for the ultimate tightness of the line within the above test requirements.

The Contractor will perform joint testing per ASTM C1103 when required by the Engineer.

TELEVISION INSPECTION

Seven days after the completion of the backfilling of each section of new pipe, as defined as a length of pipe between two manholes, the Contractor will provide a closed circuit televised inspection of the pipe to be presented to the Engineer in accordance with specification TV-1. The Inspector or Engineer shall be present during the recording.

The video record must show a clear picture of the inside of the new pipe. If the Engineer determines that the video record is unacceptable for review, the contractor shall re-televiser the line until an acceptable record has been submitted. No payment for the pipe will be made until the Engineer has reviewed the video file and accepted the pipe. In the event that the pipe is not acceptable for any reason relating to the proper construction of the pipe according to these specifications and BWSC standards, the Contractor will be responsible to re-excavate and repair the defects to the satisfaction of the Engineer at no additional cost.

Performing a television inspection and submitting the payment for the televised inspection will be incidental to the laying of the pipe.

MEASUREMENT AND PAYMENT

ITEM D1-10P	LAY 10 INCH PVC Sewer/Drain	L.F.
ITEM D1-12P	LAY 12 INCH PVC Sewer/Drain	L.F.
ITEM D1-15P	LAY 15 INCH PVC Sewer/Drain	L.F.
ITEM D1-18P	LAY 18 INCH PVC Sewer/Drain	L.F.
ITEM D1-18PD	LAY 18-INCH PVC Sewer/Drain	L.F.
ITEM D1-21P	LAY 21-INCH PVC Sewer/Drain	L.F.
ITEM D1-21R	LAY 21-INCH RCP Sewer/Drain	L.F.
ITEM D1-24R	LAY 24-INCH RCP Sewer/Drain	L.F.
ITEM D1-30R	LAY 30-INCH RCP Sewer/Drain	L.F.
ITEM D1-36R	LAY 36-INCH RCP Sewer/Drain	L.F.

ITEM D1-42R	LAY 42-INCH RCP Sewer/Drain	L.F.
ITEM D1-48R	LAY 48-INCH RCP Sewer/Drain	L.F.
ITEM D1-54R	LAY 54-INCH RCP Sewer/Drain	L.F.
ITEM D1-72R	LAY 72-INCH RCP Sewer/Drain	L.F.
ITEM D1-8D	LAY 8-INCH DI Sewer/Drain	L.F.
ITEM D1-10D	LAY 10-INCH DI Sewer/Drain	L.F.
ITEM D1-12D	LAY 12-INCH DI Sewer/Drain	L.F.
ITEM D1-16D	LAY 16-INCH DI Sewer/Drain	L.F.
ITEM D1-18D	LAY 18-INCH DI Sewer/Drain	L.F.
ITEM D1-24D	LAY 24-INCH DI Sewer/Drain	L.F.
ITEM D1-42D	LAY 42-INCH DI Sewer/Drain	L.F.
ITEM D1-48D	LAY 48-INCH DI Sewer/Drain	L.F.
ITEM D1-54D	LAY-54 INCH DI Sewer/Drain	L.F.

Pay items for HDPE pipe will be designated under items for HDPE Pipe.

For pipe item designation explanations see General Condition 44.

CATCH BASIN AND DROP INLET LATERALS ARE CONSIDERED MINOR DRAIN AND ARE NOT PAID FOR UNDER THE ABOVE ITEMS (SEE ITEM D1-06 BELOW).

The length of sewers/drains to be paid for under the above items shall be measured by the linear foot along the horizontal projection of the centerline of the completed sewer/drain, deducting for the lengths of manhole inverts (as measured between the inside walls of the manholes). No deductions shall be made for the length of wye-branches or other fittings.

The unit price paid for sewer or drain pipe shall include cutting and disposal of pavement and trench excavation, including disposal transportation costs, to the depths required to provide for laying the pipe at the grades shown on the drawing, furnishing and installing (including joining) all pipe

the service where it meets the elbow at the top of the chimney to the depth of excavation to make the connection to the mainline sewer or drain.

The unit price paid for chimney connections shall include full compensation for cutting and disposal of pavement and trench excavation, including disposal transportation costs, furnishing and installing all pipe, fittings and concrete required, placing and compacting backfill materials (furnished under Items A2-1 through A6-1), cleaning up and all else in connection with the construction of chimney connections for which there is no separate pay item.

06/23