

900 SEWERAGE WORK

ITEM 901 PIPE SEWERS COMPLETE IN PLACE

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901.01 Description. This work consists of the construction of pipe sewers complete in place in accordance with these specifications and in conformity with the lines and grades shown on the plans, or as established by the Engineer. This work includes: excavating for pipes and pipe bedding, clearing and grubbing, fill or embankment, and the removal of all materials necessary for placing the pipe except removals listed separately; furnishing and placing concrete or granular bedding, concrete backing or encasement, and compacted backfill, granular backfill, compacted granular backfill or concrete backfill as required; placing trench dams; constructing and subsequently removing all necessary cofferdams, cribs and sheeting; constructing and placing all necessary bulkheads; removal of water; installing all pipe joints; furnishing, installing and testing all necessary pipe of the types specified or shown on the plans; joining to existing and proposed sewers and appurtenances as required; restoration of disturbed facilities and surfaces; maintenance of traffic, drainage and existing facilities all as shown on the drawings and as specified, unless otherwise provided for by separate pay items. The City will specify and pay for structures under Item 604.

901.02 Materials and Material Handling. Provide pipe of the size and kind specified in the proposal and shown on the plans and meeting the requirements of the relevant parts of Section 706, Section 720 or Section 801. If the proposal or plans do not specifically itemize the type of pipe, the Contractor may use pipe from its list of approved manufacturers. The City will maintain a list of current Approved

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Manufacturers, Product Types and Sizes, and Authorization Letters on file at the Laboratory.

Provide specific materials as follows unless otherwise specified in the Contract Documents:

1. Concrete for encasement, cradle, backing and backfill Class A..... 499, 905
2. Concrete for blocking - Class C..... 499
3. Stone or gravel bedding - No. 57..... 703
4. Compacted granular material..... 912.02
5. Cement for mortar 701
6. Sand for mortar 703.03
7. Lime for mortar 712.04
8. Gaskets for Concrete Pipe Joints 901.15
9. Gaskets for Vitrified Clay Pipe Joints 901.15
10. Gaskets for PVC Pipe Joints..... 901.15
11. Gaskets for Ductile Iron Pipe Joints..... 901.15
12. Non-Reinforced Concrete Pipe 706.01
13. Reinforced Concrete Pipe 706.02
14. Reinforced Elliptical Concrete Pipe 706.04
15. Vitrified Clay Pipe, Extra Strength..... 706.08
16. Polyvinyl Chloride (PVC) Sewer Pipe 720
17. Ductile Iron Pipe 801.03
18. Precast Reinforced Concrete Box Sections 706.05
19. High Density Polyethylene Pipe (HDPE) 720

Exercise care in material handling to prevent field and installation damage that could impair the function and durability of the installation. In particular, carefully handle thermoplastic conduits during cold weather.

901.03 Excavation. Excavate all material of whatever nature encountered, including rock in place, as defined in Item 903, except for rock excavation as specified separately, made necessary for the construction of work as shown on the Standard Drawings or plans and as specified. Provide open trench excavations, except as otherwise required, permitted or ordered in writing by the Engineer.

Sawcut all existing pavements, walkways, curbs, etc. before removal. If during construction, the Contractor damages pavements, walkway, curb, etc. beyond the original saw cut, recut the damaged area to neat lines as directed by the Engineer. Include the cost of saw cutting in the items of the contract and the City will not pay separately.

901.04 Limit as to Width of Trench. Do not exceed the specified width of trench below the elevation of the outside top of the barrel of the sewer as shown on the Standard Drawings, unless included on the plans or permitted in writing by the Engineer. Provide, install, and use sufficient sheeting, bracing, timbering, etc., to maintain the sides of the trench in a substantially vertical position; and, in such a manner to protect and preserve, life, property or the use of such property. The City will not pay separately for such sheeting, bracing, timbering, etc. necessitated by the Contractor's operations to accomplish and carry out this responsibility.

For sewer installations within an embankment or for sewers above existing ground, construct the embankment, in accordance with Section 203 requirements, at least to 30 inches (0.76 m) above the outside top of the sewer pipe before trenching. Then excavate the trench to the minimum width necessary for proper placing and backfilling of the sewer as described in 901.17.

For installation of thermoplastic pipe, excavate the trench in accordance with the Standard Drawings or ASTM D2321, 6.1 through 6.5 where more restrictive than set forth above.

901.05 Unauthorized Excavation. The Engineer will classify as unauthorized excavation all excavation outside or below the limiting lines for bedding as shown on the standard drawings. Fill with material and in a manner approved by the Engineer at no additional cost to the City.

901.06 Subgrade. The City expects the Contractor will find satisfactory material at the subgrade of the trench if the Contractor performs adequate water removal. If the Contractor encounters soft, spongy, unsuitable or similarly unacceptable material at the bedding subgrade, remove this unsuitable material as directed by the Engineer in writing. The following will govern the prosecution of the work directed by the Engineer.

1. If Contractor dewatering of the subgrade materials in accordance with Item 901.16, produces a subgrade acceptable to the Engineer for placing the bedding material, the City will not make additional payment for the work.
2. After dewatering of subgrade materials in accordance with Item 901.16, for unsuitable material removed by written order of the Engineer, replace with a stone foundation as specified in Item 906 and paid for as indicated therein.

901.07 Excavation Material. Dispose of all excavated material in excess of that required for backfilling. Do not use public or private property for this purpose without the written permission of the Owner. The Contractor may store excavated material required for backfill, except as provided for under Surface Soil as per Section 901.18, on the bank of the trench in accordance with applicable safety and environmental regulations where space is available within the right-of-way acquired for the work. Do not interfere with the access to and maintenance of traffic, drainage and utilities as herein specified.

Secure the Engineer's approval of the location of an off-site disposal area before using.

Maintain ingress and egress to all properties along the line of the work, except as permitted, in writing, by the Engineer.

901.08 Removal of Obstructions. Remove any obstructions, including abandoned sewers or water lines, encountered or necessary for the construction of the work at no additional cost to the City as approved by the Engineer.

For existing pipes encountered in removal operations, determined inactive by the Engineer, fill and plug or seal at both ends where broken.

For abandoned and removed portions of an existing concrete or clay sewer under this Contract, construct brick or concrete bulkheads in the undisturbed section of the abandoned sewer as directed by the Engineer. The drawings may or may not show the

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locations of bulkheads. For abandoning existing sewer made of a material other than clay, brick or concrete, cap or plug the undisturbed section as directed. The cost of this work is included in the various items of the contract and the City will not make a separate payment, unless a separate pay item is specified.

901.09 Maintaining Drainage. Maintain the flow of all sewers, drains, streets, gutters, field tiles and watercourses encountered at no additional cost to the City. Restore to a condition satisfactory to the Engineer and applicable jurisdictional authority any watercourses and drains disturbed or destroyed during the prosecution of the work at no additional cost to the City.

901.10 Maintenance of Service in Existing Structures. Maintain in service all existing overhead, surface or subsurface structures, together with all appurtenances and service connections, except those otherwise provided for herein, encountered or affected in any way during the construction of any of the work under this contract at all times, unless the Contractor makes other arrangements, satisfactory to the authority responsible for their operation.

For connections made to existing sewers, make suitable provisions for maintaining the flow in the existing sewer until the completion of the connection.

Include the cost of this work in the prices bid for all the various items of the contract.

901.11 Bedding and Embedment. Place cutoff trench dams of native clay or impervious soil across and along the trench at 150 foot (45.7 m) intervals. Place at least 1 trench dam between adjacent manholes regardless of spacing. Compact the trench dams 6 feet (1.8 m) in length, as measured along the sewer centerline and bench into the undisturbed trench sides from the subgrade or top of cradle, to within 5 feet (1.5 m) of the existing surface. If constructing trench dams in rock or hardpan, extend to the top thereof whichever is greater. Where pipe cover is less than 5 feet (1.5 m) the extend the dam to within 1 foot (0.3 m) of the existing surface. Provide the trench dam installation with a minimum of 3 feet (0.9 m) of compacted material above the crown of the pipe.

Type I.

1. For flexible sanitary and storm sewers 6 inches (152 mm) in diameter up to and including 60 inches (1524 mm) in diameter, provide a bedding of No. 57 stone or compacted granular material in accordance with Section 912.02 extending from a point 4 inches (101 mm) below the bottom of the pipe to a point 12 inches (305 mm) above the outside top of pipe as shown on the standard drawings.
2. For rigid sanitary and storm sewers 6 inches (152 mm) in diameter up to and including 27 inches (685 mm) in diameter, provide a bedding of No. 57 stone or compacted granular material in accordance with Section 912.02 extending from a point 4 inches (102 mm) below the bottom of the pipe to spring line of the pipe as shown on the standard drawings.
3. For rigid sanitary and storm sewers 30 inches (762 mm) in diameter up to and including 108 inches (2743 mm) in diameter, provide a bedding of No. 57 stone or compacted granular material in accordance with 912.02 extending from a point 6 inches (152 mm) below the bottom of the pipe to the spring line of the pipe as shown on the standard drawings.

If using Type I bedding, include the cost of all bedding as described above in the price bid for the various pipe items. If compacted granular material fails to meet the compaction required under Section 912.03, under pipe haunches and around the pipe, the Engineer will direct the use of stone bedding, No. 57, in lieu of compacted granular material at no additional cost to the City.

Provide embedment for thermoplastic pipe used in areas where lateral soil support is negligible or questionable in accordance with the recommendations of ASTM D2321 Appendix XI Commentary.

Type II.

Set sanitary and storm sewers to line and grade on Class C Concrete Blocking meeting the following minimum requirements:

1. Provide concrete blocking with a horizontal bearing area in contact with the subgrade creating the bearing load not exceeding 3,000 pounds per square foot (14,646 kg/m²).
2. Provide concrete blocking that supports the pipe at least 6 inches (152 mm) above the subgrade.
3. Allow concrete to remain exposed until completion of the initial set.

Construct a Class A Concrete Cradle to fill all the space around the concrete blocking and below the pipe as shown on the standard drawings. The City will deem all concrete placed outside the limiting lines for trench width and elevation as unauthorized and will not include for payment. Provide backing of stone bedding or compacted granular material as described in Type I bedding unless Class A Concrete is specified, or shown on the drawings.

For Type II bedding, include the cost of all bedding as described above in the price bid for the various pipe items.

Fill all the space within the width of the trench excavation, inside or outside the authorized limits and between the elevation limits, with the same material as specified on the applicable standard drawing.

901.12 Laying Pipe. Examine each pipe for defects and damage. Do not use defective or damaged pipe. Lay pipelines to the grades and alignment indicated. Provide proper facilities for lowering sections of pipe into trenches. Do not, under any circumstances lay pipe in water or when trench conditions or weather prove unsuitable for such work. Provide for the diversion of drainage or dewatering of trenches during construction as necessary. Inspect all pipe in place before backfilling, and remove and replace those pipes damaged during placement.

Lay pipes in finished trenches starting at the lowest point so that the spigot ends point in the direction of flow. Lay all pipes with ends abutting and true to line and grade.

Where necessary with bell end pipe, excavate suitable bell-holes in the bedding material for the bell of each pipe so that the bells will not support the weight of the pipe. Fit and match the pipes so that when placed, they will form a conduit with a smooth and uniform invert. Use all possible care when shoving the pipes together to minimize the joints and carefully clean the pipe ends before placing the pipes. Install gaskets in accordance with the manufacturer's recommendations.

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Use Class A concrete encasement, in accordance with to the dimensional standard drawing, within the limits of existing or proposed paved areas inside right-of-way where minimum cover during construction or proposed cover over the outside top of the pipe to top of finished grade is 48 inches (762 mm) or less.

Make all connections with existing structures after cleaning the structures in a thorough, first class, neat and workmanlike manner acceptable to the Engineer. Include the cost of this work in the price bid for the various pipe items.

901.13 Bulkheads. Construct a bulkhead at the start of construction of Sanitary Sewers, and remove same bulkhead after placing all pipes and manholes, removing all water, testing the sewer, and receiving approval from the City.

Seal the outer ends of all concrete, brick or clay pipe stubs with a brick masonry bulkhead. Construct bulkheads 8 inches (203 mm) thick for stubs 21 inches (533 mm) and larger in diameter, and 4 inches (102 mm) thick for stubs smaller than 21 inches (533 mm) in diameter. Plaster all bulkheads with a 1/2 inch (13 mm) coat of mortar. Include the cost of this work in the price bid for various pipe items.

Plug or cap all thermoplastic pipe stubs in a manner acceptable to the Engineer using a fitting as approved by the pipe manufacturer.

901.14 Sanitary Sewers. Do not connect roof drains, foundation drains and other clean water connections to sanitary sewers.

901.15 Pipe Joints.

Sanitary Sewers

Concrete. Provide pipe joints conforming to the requirements of ASTM C 443 and as specified herein. Use solid gaskets of circular cross section confined in an annular space formed by the shoulder on the bell and spigot or in the groove in the spigot of the pipe so that movement of the pipe or hydrostatic and hydrodynamic pressure cannot displace the gasket. When the joint is assembled, compress the gasket to form a watertight seal.

Provide all elliptical reinforced concrete pipe for sanitary sewers with Type B - mortar joints and ASTM C 877 rubber and mastic sealing band.

Vitrified Clay. Provide pipe joints conforming to the requirements of ASTM C 425 Compression Joints for Vitrified Clay Bell and Spigot Pipe.

Type PSM Poly Vinyl Chloride (PVC) Sewer Pipe. Provide pipe joints conforming to the requirements of ASTM D 3212.

Ductile Iron. Use mechanical or push on joints meeting AWWA C111 or restrained joints meeting AWWA C110 or C153.

Storm Sewers

Concrete. Use pipe joints conforming to one of the following:

Type A Rubber Gasket. Meet the requirements of ASTM C 443.

Type B Mortar. On sewers 30 inches (762 mm) in diameter and larger, lay the groove end of the pipe to line and grade and wash with a wet brush and butter the bottom half of

the groove with 1 to 2 Portland Cement mortar. Clean the tongue of the next section of pipe with a wet brush and apply a layer of 1 to 2 Portland Cement mortar to the top half of it. Then fit the tongue end of the second pipe into the groove end of the first pipe until the mortar is squeezed out onto the inner and outer surfaces. Point the inner surface of the pipe at the joint and smooth with a long handled brush. Point the outside with a bead of mortar. If the joint opening on the bottom half of the pipe exceeds 1/2 inch (13 mm), fill with 1 to 2 Portland Cement mortar.

Type C Bituminous pipe joint filler. Meet the requirements of Section 706.10.

Type D Preformed butyl rubber material. Meet the requirements of 706.14. For concrete pipe 78 inch (2.0 m) diameter and over, prime the annular mating surfaces

Vitrified Clay. Construct pipe joints conforming to one of the following:

Type A Compression. Meet the requirements for vitrified clay pipe joints used in sanitary sewers as specified herein.

Type C Bituminous filler. Meet the requirements of 706.10.

Type D Preformed butyl rubber material. Meeting the requirements of 706.14.

High Density Polyethylene. Construct pipe joints conforming to one of the following:

Type A pipe joints. Meet the requirements of ASTM D 3212.

Type B pipe joints. Meet the requirements of AASHTO M-252, M-294, and Section 23 of the Standard Specification for Highway Bridges, Division II. Construct joints "silt tight" with bell and spigot connection. Provide bells either integrally joined to the pipe, or with separate sleeves (double-belled) designed to join the pipe in the field. The Contractor may use split couplings or separate sleeves to make field repairs.

For all elliptical reinforced concrete pipe for storm sewers, use Type B – mortar or, Type C Bituminous pipe joint filler. Where conditions dictate the use of other types of joints, the City will note such on the plans.

The Contractor may use preformed rubber coupling rings, Fernco 5000 series or approved equal, if approved by the Engineer, when performing field repairs on both rigid and flexible pipes for both sanitary and storm sewer applications. Ensure the rubber sleeve and steel bands make a tight seal capable of meeting the leakage requirements as specified in Item 901.20. Use preformed rubber coupling rings, Fernco 5000 series, only to join pipe of similar material. Perform all installations of the preformed rubber coupling ring, Fernco 5000 series, in conjunction with the City of Columbus standard drawings.

When connecting pipes of dissimilar materials, use the type of coupler specifically manufactured for making the connection between said materials (i.e. concrete to clay, clay to plastic, etc.). Complete the repair by removing the existing pipe to the nearest structurally sound joint and install the new pipe in accordance with all applicable sections of Item 901. Sawcut existing pipe in a neat workmanlike manner, making the cut perpendicular to the longitudinal axis of the pipe. Include the cost of this work in the price bid for the various pipe items, unless directed otherwise by the Engineer.

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901.16 Removal and Disposal of Water. During construction, provide proper and satisfactory means and devices for the removal and disposal of all water entering the excavations and remove all such water as fast as it collects to prevent interference with the prosecution of the work. Dispose of water in accordance with applicable erosion and sediment control requirements.

901.17 Backfilling. Backfill all trenches and excavations, in general, from 12 inches (305 mm) above the top of the pipe, as specified in this section, as soon after the completion of sewers or other structures as circumstances allow, in the opinion of the Engineer.

For rigid pipe sizes 6 inches (152 mm) to and including 108 inches (2743 mm) in diameter, select and place backfill using finely divided job excavated earth that is free from debris, organic or frozen material and stones larger than 2 inches (50 mm) in their greatest dimension, from the top of the granular bedding or concrete backing, as shown on the standard drawing, to a level not lower than 12 inches (305 mm) above the outside top of the pipe. Place the selected backfill layer above the crown of the pipe in lifts of 6 inches (152 mm) or less, carefully tamped, in order to produce a cushion over the pipe to prevent its breakage during the placing of the remaining trench backfill material. The Contractor may use granular bedding material for the selected backfill layer, at no additional cost to the City.

When earth backfilling open trench excavations, use the best excavated earth, free from rubbish, and excessive frozen material. The Contractor may deposit occasional boulders or stones not larger than 1 cubic foot (cubic meter) at least 2 feet (0.6 m) above the top of the sewer, subject to the approval of the Engineer.

Where the contract requires concrete cradle, encasement or backing, allow at least 2 hours or sufficient time for initial set to elapse before placing granular backing, pipe protection or backfill. Employ a method for depositing the backfill to prevent damage to the sewer or other structures. Do not backfill concrete structures built in place until approved by the Engineer.

Where cradling, encasing or backing ductile iron sewer pipe, wrap the pipe the length of the encasement and at least 30 feet beyond both ends of the concrete applied.

Where cradling and/or encasing thermoplastic pipe in concrete, the length of the encasement shall extend from manhole to manhole for the encased section of pipe.

Except where the plans note other requirements, or provided for in the specifications, or directed by the Engineer, provide material for all open trench backfill above the elevation of the bedding material of the sewer having the same as or better soils characteristics than the adjacent undisturbed soil or materials, subject to other provisions of the specifications for compaction or special fill, in a manner satisfactory to the Engineer. Perform all backfilling operations and placement of the backfill material by such means to eliminate damage to the sewer, its appurtenant structures, and other adjacent structures.

Perform settlement of the backfill by flushing or ponding as shown by notes on the plans or as otherwise approved in writing by the Engineer.

Backfill all trenches that cross existing or proposed pavement (including berm) or where the front face of trenches, paralleling the pavement, is within 36 inches (0.9 m) of

the face of curb or edge of pavement (including berm) with compacted granular material in accordance with the Standard Drawings. Compact other areas outside the above requirement, but inside the right-of-way, in accordance with Item 911.

Where sewer construction is in existing lawn areas outside proposed or existing right-of-way, compact the backfill to a minimum 90 percent maximum dry density.

Backfill or securely plate all trenches within the road right of way during non-working hours.

Exercise care during backfilling and compaction to avoid displacement of or injury to pipe. Movement of construction machinery over a pipe at any stage of construction shall be at the Contractor's own risk. Repair or replace any damaged pipe at no additional cost to the City.

Refill any settlement in the open trench backfill taking place within the guarantee period with satisfactory materials and repair the affected surface at no additional cost to the City.

901.18 Surface Soil and Restoration of Surface. Before starting trench excavation, remove the surface soil to a depth of not less than that of the topsoil material to a maximum of 12 inches (305 mm) below the original surface of the ground within the excavation limits, except where otherwise specifically exempted or provided. Segregate and store surface soil separately from the remaining stored excavated material. In cultivated areas, strip the entire work area, including storage areas for backfill, up to 12 inches (305 mm) deep and store for reuse. If necessary, acquire additional area to provide for such separate storage of surface soil. After the completion of sewer construction and basic trench backfill, place a minimum of 4 inches (102 mm) of suitable surface soil within the construction limits up to a depth of not less than that of the original topsoil, or a maximum of 12 inches (305 mm). Allow for adequate surface soil thickness and leveling in embankments and re-excavate the basic trench backfill if necessary to allow for the surface soil fill. Provide final grades conforming to those shown on the plans. Obtain the surface soil for this requirement during initial trench excavation or furnish from other sources at no additional cost to the City.

Perform restoration of all surfaces as the work progresses and cease excavation and pipe laying until such restoration work is accomplished, as directed by the Engineer. In locations where surface soil is replaced and settlement below the original ground surface occurs within the guarantee period, refill with surface soil equivalent to the original material. Include the cost of all work and other expenses connected with the surface soil operation in the Contract Price for the various sewer items. The City will not pay separately.

Replace all surfaces, including grass or lawn, pavement, sidewalk, curbing and other surfaces disturbed or destroyed during and as a result of the construction of the work.

Seed all areas disturbed in accordance with the requirements of this section, unless otherwise stated on the plans. Perform the seeding operation in conformance with the requirements set forth under Item 659, within 30 days weather permitting.

Repair or replace all fences damaged or removed in connection with the construction of the sewer to the satisfaction of the Engineer. If necessary, provide temporary fencing.

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Include in the prices bid for the sewer items, the cost of all such restoration in all areas involved above and adjacent to the work. The City will not pay separately unless specifically provided for under other items.

901.19 Trees. The Contractor may remove all branches or growth from trees the plans call for saving that interfere with the free construction of the pipe sewer, in accordance with Item 666 and at the direction of the Engineer. Include the cost of all work and expenses connected with the removal of branches in the price bid for the various sewer items. The City will not pay separately.

901.20 Leakage Tests. Do not exceed the allowable limits of leakage for all completed and installed sanitary and storm sewer pipe as follows:

1. **Sanitary Sewers:** 100 gallons per inch (378.5 L/mm) of tributary pipe diameter per 24 hours per mile (km) of length or the computed equivalent for shorter lengths and shorter periods of time. Test all sanitary sewers.
2. **Storm Sewers:** 1,000 gallons per inch (3785 L/mm) of tributary pipe diameter per 24 hours per mile (km) of length or the computed equivalent for shorter lengths and shorter periods of time. Perform tests on storm sewers only using the infiltration method and only if indicated on the plans.

Perform leakage tests after the deflection tests for flexible sewer pipe applications.

Perform the following leakage tests after cleaning all installed pipe and manholes and removing obstructions:

1. **Infiltration Test.** Conduct this test when the height of the ground water table is two feet or more above the elevation of the inside crown of pipe at the upstream limit of the tested section. Perform the infiltration test by installing a weir or other measuring device approved by the Engineer in the lower end of the sewer tested section. Measure the quantity of ground water infiltration into the sewer Do not exceed the allowable leakage.
2. **Exfiltration Test.** Conduct this test when the height of the ground water table is less than two feet above the elevation of the inside crown of pipe at the upstream limit of the tested section. Unless otherwise directed by the Engineer or indicated on the plans, perform testing section by section where a section consists of the distance between the successive manholes. Close the inlet ends of the upstream and downstream manholes with watertight bulkheads. Fill with water the sewer and the upstream manhole until the elevation of the water in the upstream manhole is two feet higher than the inside crown of the pipe in the tested, or two feet above the existing ground water in the trench, whichever is the higher elevation. The Contractor may fill and maintain full of water the length of tested section for a period of approximately 24 hours prior to the start of the test. If the water level in the upper manhole drops during this 24 hour period, raise the level to the test elevation mark before measuring the leakage. If performing the test at any time during the 24 hour period, set the water at the test elevation mark and perform the test.

Determine the exfiltration by measuring the volume of water added to return the surface of the water in the upstream manhole to the test elevation mark. Use a test period of at least 1 hour duration from the start of the test.

After the completion of the exfiltration test, the Engineer, may order the test section drained and measurement of infiltration from existing ground conditions within three hours by means of a weir located in the downstream manhole.

The allowable leakage is based on a maximum difference in elevation of 8 feet (2.4 m) between the level of water in the upper manhole and the invert of the bulkheaded pipe at the downstream manhole. If the difference in elevation exceeds 8 feet (2.4 m), increase the allowable leakage five percent for each 1 foot (0.3 m) in excess of 8 feet (2.4 m).

3. **Manhole Test.** Test manholes by plugging connecting pipes and filling with water to 2 feet (0.6 m) above the crown of the highest entering pipe. Fill the manhole and let stand for 24 hours. A passing test requires no loss of water in a 4 hour period. As an alternative to this test procedure, and if approved by the Engineer, the Contractor may perform a vacuum test in accordance with the procedures set forth in ASTM-C-1244.
4. **Air Test.** In lieu of exfiltration tests required for pipe sizes 8 inches (203 mm) through 24 inches (610 mm) under Section 901.20 (b) and if approved by the Engineer, the Contractor may request an air test for checking tightness of sanitary sewer pipe construction. Test all sections of pipe between manholes.

Air test pipes using equipment approved by the Engineer and in accordance with the following steps:

- a. Plug all pipe outlets with suitable test plugs. Brace each plug securely.
- b. Add air slowly to the portion of the pipe installation under test until the internal air pressure is raised to 4.0 psig.
- c. After obtaining an internal pressure of 4.0 psig, allow at least 2 minutes for air temperature to stabilize, adding only the amount of air required to maintain pressure.
- d. When pressure decreases to 3.5 psig, start stop-watch. Determine the time in seconds required for the internal air pressure to reach 2.5 psig. Use minimum permissible pressure holding times for runs of single pipe diameter and for systems of 6 inches or 8 inches (152 or 203 mm) laterals in combination with trunk lines published in tables by the National Clay Pipe Institute for vitrified clay pipe, ASTM C-924 for concrete pipe, and Table 1 in UNI-B-690 by Uni-Bell PVC Pipe Association for PVC pipe.

If the leakage exceeds the allowable limits, determine the location where excess water is entering or leaving the sewer. Replace or repair the sewer and/or manholes with materials approved by the Engineer. Retest until the leakage is within the allowable limits. Include, in the price bid per linear foot (meter) of sewer, the cost of all bulkheads, plugs, pipe stopper, pumps, compressors, water, weirs, labor, delay, and any other items

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of cost necessary for the performance and completion of the required leakage test and for the cost of any repairs or adjustments necessary to conform to the required allowable leakage limits.

Conduct all leakage tests in the presence of the Engineer.

901.21 Deflection. Before final acceptance of completed flexible sewer lines by the Engineer, perform a pipe deflection test on all main line sanitary sewers and storm sewers where required at no additional cost to the City.

Measure all lines for vertical ring deflection no sooner than 30 days after completion of backfilling operations, if sufficient settlement of the backfill has occurred, as determined by the Engineer. The Engineer's determination of sufficient settlement is final.

Do not exceed the maximum limit of vertical deflection of 5 percent. Calculate the 5 percent using the applicable ASTM or AASHTO procedures. Perform the test by manually pulling a City of Columbus approved "go, no-go" mandrel with 9 arms.

Provide all equipment and labor, including mandrel, to perform and conduct the required test. Notify the Engineer at least 48 hours in advance of the anticipated date of the testing to schedule personnel needed to monitor the testing operations.

In areas where deflections exceed the 5 percent limit, correct the problem area(s) at no additional cost to the City. Where correction is required, the City will pre-approved one of the following procedures for the Contractor to utilize:

1. Re-excavate the trench, and remove and replace the backfill and pipe in accordance with the original plans and specifications. If, in the opinion of the Engineer or his representative, the Contractor has damaged the pipe, replace the pipe with new pipe and install per the plans and specifications. Retest the failed sections of pipe corrected by this method in accordance with Section 901.21 no sooner than 30 days after the correction is made or as otherwise directed by the Engineer.
2. Re-round the failed section(s) using an approved company providing this service. Submit methods, types of equipment, and company to provide service in writing to the Engineer for approval 5 working days before performing this procedure. Use this method only if approved by the Engineer and the deflection has not exceeded 10 percent of the base inside diameter of the pipe. Determine the deflection by pulling a 9 arm "go, no-go" mandrel having a diameter equal to 90 percent of the base inside diameter of the pipe.

After completing either procedure 1 or 2, retest the repaired area(s) in accordance with Section 901.20 and Section 901.21 before final acceptance.

901.22 Method of Measurement. The Engineer will measure and accept the length of pipe by the linear feet (meters), as measured along the centerline of the sewer, complete in place, including lengths to the center of manholes, inlets, and tunnel shafts. For an extended stub or branch stub at a manhole, if more than one length of pipe extends beyond the wall of a manhole, the Engineer will measure from the center of the manhole to the end of the stub, unless the payment for such stub is otherwise provided. .

901.23 Basis of Payment. The City will pay accepted quantities of sewer of the sizes and types specified at the contract unit prices per linear foot (meter), complete in place.

The City will pay under:

Item	Unit	Description
901	Linear Foot (Meter)	____ Pipe, with Type ____ Bedding
901	Linear Foot (Meter)	____ Pipe, with Type ____ Bedding, with Item 911 Compacted Backfill
901	Linear Foot (Meter)	____ Pipe, with Type ____ Bedding, with Item 912 Compacted Granular Material