

SEWER SPECIFICATIONS
S100

Rochester, MN

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Section 1 GENERAL REQUIREMENTS

S100.101 Description

This work shall consist of the construction of pipe sewers utilizing plant fabricated pipe and other appurtenant materials, installed for conveyance of sewage or storm water. The work includes construction of manhole and catch basin structures and other related items as specified.

The City of Rochester reserves the right, at any time during the construction of any sewer embraced within the limits of this contract, to issue a permit to a property owner to connect premises to the sewer. In the event such a permit is issued, the Contractor is not relieved of the responsibility to complete their contract according to Plans and Specifications. The issuance of a permit by the City to tap or connect to any part of a sewer embraced within the limits of this contract shall in no sense be construed as acceptance of any part of the work.

The use of the term "Plans, Specifications, and Special Provisions" within this specification shall be construed to mean those documents which compliment, modify, or clarify these specifications and are accepted as an enforceable component of the Contract Documents.

S100.102 Reference Documentation

Provisions of the General Conditions and Trench Excavation & Backfill/Surface Restoration shall apply to this work. The Contractor shall abide by the applicable provisions of state, federal and local laws and ordinances.

All references to Mn/DOT Specifications shall mean the latest published edition of the Minnesota Department of Transportation "Standard Specifications for Construction", and all supplements and amendments thereto published prior to the date of advertisement for bids. All references to other Specifications of AASHTO, ASTM, ANSI, AWWA, etc. shall mean the latest published edition available on the date of advertisement for bids.

The following specifications have been referenced in this Specification:

AASHTO M198	Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
AASHTO M306	Standard Specification for Drainage Structure Castings
ASTM A48	Standard Specification for Gray Iron Castings
ASTM A798	Standard Practice for Installing Factory Made Corrugated Steel Pipe for Sewers and Other Applications
ASTM C76	Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C270	Standard Specification for Mortar for Unit Masonry
ASTM C361	Standard Specification for Reinforced Concrete Low Head Pressure Pipe
ASTM D 412	Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension
ASTM C443	Standard Specification for Joints Concrete Pipe and Manholes Using Rubber Gaskets
ASTM C478	Standard Specification for Precast Reinforced Concrete Manhole Sections
ASTM C1244	Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill
ASTM D543	Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents
ASTM D638	Standard Test Method for Tensile Properties of Plastics
ASTM D792	Standard Test Methods for Density and Specific Gravity of Plastics by displacement
ASTM D1603	Standard Test Method for Carbon Black in Olefin Plastics
ASTM D2241	Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure Rated Pipe (SDR Series)
ASTM D2321	Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and

	Other Gravity Flow Applications
ASTM D3034	Standard Specification for PVC Sewer Pipe and Fittings
ASTM D3212	Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D3262	Standard Specification for “Fiberglass” (Glass Fiber Reinforced Thermosetting Resin) Sewer Pipe
ASTM D4161	Standard Specification for Fiberglass (Glass Fiber Reinforced Thermosetting Resin) Pipe Joints Using Flexible Elastomeric Seals
ASTM D4437	Standard Practice for Determining the Integrity of Field Seams Used in Joining Flexible Polymeric Sheet Geomembranes
ASTM D4787	Standard Practice for Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrates with reference to NACE Standard Practice Discontinuity (Holiday) Testing of Protective Coatings RP 0188-88 or Practice D5162
ASTM D5641	Standard Practice for Geomembrane Seam Elevation by Vacuum Chamber
ASTM F679	Specification for Large-Diameter PVC Sewer Pipe and Fittings
ASTM F794	Standard Specification for Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter
ASTM F949	Standard Specification for Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe With a Smooth Interior and Fittings
ASTM F1417	Standard Practice for Installation Acceptance of Plastic Non pressure Sewer Lines Using Low Pressure Air
AWWA C104	American National Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings
AWWA C110	American National Standard for Ductile-Iron and Gray-Iron Fittings
AWWA C111	American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115	American National Standard for Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges
AWWA C116	Standard for Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings
AWWA C150	American National Standard for Thickness Design of Ductile-Iron Pipe
AWWA C151	American National Standard for Ductile-Iron Pipe, Centrifugally Cast
AWWA C153	American National Standard for Ductile-Iron Compact Fittings for Water Service
AWWA C550	Standard for Protective Interior Coatings for Valves and Hydrants
AWWA C900	Polyvinyl Chloride (PVC) Pressure Pipe, 4 in. through 12 in.
AWWA C905	Polyvinyl Chloride (PVC) Pressure Pipe, 14in. through 48 in.
AWWA M45	Fiberglass Pipe Design.

Section 2 MATERIALS

S100.201 General

All materials required for this work shall be new material conforming to requirements of the referenced specifications for the class, kind, type, size, grade, and other details indicated in the Contract. Unless otherwise indicated, all required materials shall be furnished by the Contractor. If any options are provided for, as to type, grade, or design of the material, the choice shall be limited as may be stipulated in the Plans, Specifications, or Special Provisions.

All manufactured products shall conform in detail to such standard design drawings as may be referenced or furnished in the Plans. Otherwise, the City may require advance approval of material suppliers, product design, or other unspecified details, as it deems desirable for maintaining adopted standards.

Wherever connection of dissimilar materials or designs is required, the method of joining and any special fittings employed shall be products specifically manufactured for this purpose and subject to approval by the Engineer.

S100.202 Alternate Pipe for Sanitary Sewer

A. 8 – 12 inch diameter

Sanitary sewers shall be constructed of the following materials unless otherwise specified:

1. Polyvinyl Chloride (PVC) Pipe ASTM D2241
2. Polyvinyl Chloride (PVC) Pipe ASTM D3034
3. Polyvinyl Chloride (PVC) Pipe ASTM F949
4. Polyvinyl Chloride (PVC) Pipe AWWA C900

B. 15 – 36 inch diameter

Sanitary sewers shall be constructed of the following materials unless otherwise specified:

1. Polyvinyl Chloride (PVC) Pipe ASTM D2241
2. Fiberglass Sewer Pipe ASTM D3262
3. Polyvinyl Chloride (PVC) Pipe ASTM F679
4. Polyvinyl Chloride (PVC) Pipe ASTM F794
5. Polyvinyl Chloride (PVC) Pipe ASTM F949
6. Polyvinyl Chloride (PVC) Pipe AWWA C905

C. 42 inch diameter and larger

Sanitary sewers shall be constructed of the following materials unless otherwise specified:

1. Fiberglass Sewer Pipe ASTM D3262 and D4161
2. Polyvinyl Chloride (PVC) Pipe ASTM F679
3. Polyvinyl Chloride (PVC) Pipe AWWA C905

D. Close Proximity to Watermains.

Sanitary sewers in close proximity to watermains shall be constructed of the following materials unless otherwise specified:

1. Polyvinyl Chloride (PVC) Pipe AWWA C900, C905
2. Polyvinyl Chloride (PVC) Pipe ASTM D2241

S100.203 Ductile Iron Pipe and Ductile Iron Fittings

The pipe furnished shall be Ductile Iron pipe and fittings furnished shall be of the Ductile Iron type as specified for each particular use of installation.

All Ductile Iron pipe systems shall be fully encased in polyethylene film meeting the requirements of these Specifications and City Standard Detail Plate.

Ductile iron pipe shall conform to the requirements of AWWA C115 or C151 for water and thickness design shall conform to AWWA C150. In addition, the pipe shall comply with the following supplementary provisions:

1. Fittings shall conform to the requirements of AWWA C110 or 153 (Ductile iron Fittings) for the joint type specified.
2. Unless otherwise specified, all pipe and fittings shall be furnished with cement mortar lining meeting the requirements of AWWA C104 for standard thickness lining. All exterior surfaces of the pipe and fittings shall have an asphaltic coating at least one mil thick. Spotty or thin seal coating, or poor coating adhesion, shall be cause for rejection.

Fittings specified to be furnished with fusion bonded epoxy external coating and/or interior lining shall conform to the requirements of AWWA C550 and C116/A21.16, with 6-8 mil nominal thickness.

3. Rubber gasket joints for Ductile Iron Pressure Pipe and fittings shall conform to AWWA C111.
4. The nuts and bolts shall be constructed of corrosion resistant, high-strength, low-alloy steel with a ceramic filled, baked on fluorocarbon resin. The nuts and bolts shall be in compliance with ANSI/AWWA C111/A21.11 (Current Revision).
5. Conductivity, when required by the Special Provisions, shall be maintained through pipe and fittings with an external copper jumper wire or specialty gaskets which are capable of meeting conductive requirements. Wedge type connectors will not be allowed.

S100.204 Reinforced Concrete Pipe and Fittings

A. Storm sewer

Reinforced concrete pipe, fittings and specials shall conform to the requirements of Mn/DOT Section 3236 & Plate 3006, ASTM C76 & C443, and the following supplementary provisions:

1. All branch fittings such as tees, etc. shall be cast as integral parts of the pipe. All fittings and specials shall be of the same strength class as the pipe to which they are attached.
2. Tie all joints on Centerline Culverts, slopes greater than 10 %, and pipes terminating as an outfall.

S100.205 Corrugated Steel Pipe and Fittings

Corrugated Steel (CS) Pipe and fittings shall conform to the requirements of Mn/DOT 2501, 2503, and 3226 (CS) Pipe for the application, type, size and sheet thickness specified. Joints for joining CS Pipe shall be the band type or bell/spigot type, soil-tight and watertight, with preformed gasket seals meeting Mn/DOT 3726. Fittings and bands for joining pipe sections shall be of the same material and thicknesses as the mainline pipe.

Specialty coatings for the pipe shall be as indicated in the Plans, Specifications, and Special Provisions.

S100.206 Polyvinyl Chloride Pipe and Fittings

Smooth walled polyvinyl chloride pipe and fittings shall conform with the requirements of ASTM D3034, ASTM D2241, AWWA C900, and ASTM F679 for the size, standard dimension ratio (SDR), and strength requirements indicated on the Plans, Specifications, and Special Provisions. The grade used shall be resistant to aggressive soils or corrosive substances in accordance with the requirements of ASTM D-543. Unless otherwise specified, all pipe and fittings shall be a minimum SDR 35, and minimum SDR 26 for

depths 20ft and greater, or diameters 42 inches and larger. Connections shall be push-on with elastomeric gasketed joints which are bonded to the inner wall of the gasket recess of the bell socket.

Controlled inside diameter, (Closed or Open Profile) polyvinyl chloride pipe and fittings with smooth interior shall conform to the requirements of ASTM F-794 for the size and wall thickness indicated on the Plans, Specifications, and Special Provisions. Unless otherwise specified, all pipe and fittings shall be push-on with snug fit elastomeric joints meeting tightness requirements of ASTM D3212.

Corrugated polyvinyl chloride pipe and fittings with smooth interior shall conform to the requirements of ASTM F-949 for the size and wall thickness indicated on the Plans, Specifications, and Special Provisions. Unless otherwise specified, all pipe and fittings shall be push-on with snug fit elastomeric joints meeting tightness requirements of ASTM D3212.

S100.207 Fiberglass Reinforced Polymer Mortar Pipe

Fiberglass Reinforced Polymer Mortar Pipe shall conform to the requirements ASTM D-3262, ASTM D4161, and AWWA M45 for the size and strength requirements indicated on the Plans, Specifications, and Special Provisions.

Unless otherwise specified, all pipe and fittings shall have a minimum pipe stiffness of SN 72.

S100.208 Waterproofing Sanitary Manholes

Waterproofing sanitary manholes shall conform to the City of Rochester Detail Plate, for the size and type indicated on the Plans, Specifications, and Special Provisions. In addition, the Manhole waterproofing shall comply with the following supplementary provisions:

1. The internal barrier is the preferred waterproofing method for the adjusting rings for paved areas and external barrier for non-paved areas.
2. Where water may stand, top of manhole shall be 1-2 feet above existing grade and/or the 100 year storm water level, unless otherwise specified.

S100.209 Metal Sewer Castings

Drainage, sewer, utility, and related castings shall conform to the requirements of AASHTO M-306, ASTM A48 Class 35B, 40A, or better Standard Specification for Gray Iron Castings, subject to the following supplementary provisions:

1. Casting assemblies or dimensions, details, weights, and class shall be as indicated in detailed drawings for the design designation specified.
2. Lid-to-frame surfaces on round casting assemblies shall be machine milled to provide bearing around the entire circumference.
3. Casting weight shall be not less than 95 percent of theoretical weight for a unit cast to exact dimensions, based on 442 pounds per cubic foot.
4. A Certificate of Compliance shall be furnished with each shipment of castings stating the materials furnished have been tested and are in compliance with the specification requirements.
5. Unless otherwise specified, sanitary sewer manholes in areas subject to flooding by surface water and in concrete pavements shall have self-sealing, bolt-down, lid with an anti-seize compound applied to the threads.

S100.210 Precast Concrete Manhole and Catch Basin Sections

Precast concrete riser sections and appurtenant units (grade rings, top and base slabs, special sections, etc.) used in the construction of manhole and catch basin structures shall conform with the requirements of ASTM C-478, Mn/DOT 2506 and the following supplementary provisions:

1. The precast sections and appurtenant units shall conform to all requirements as shown on the detailed drawings.
2. Joints of manhole riser sections shall be tongue and groove with rubber "O" ring joints provided on sanitary sewer manholes. Sanitary sewer inlet and outlet pipes shall be joined to the manhole with a gasketed, flexible, watertight connection or any watertight connection arrangement that allows differential settlement of the pipe and manhole wall to take place.
3. Air-entrained concrete shall be used in the production of all units. Air content shall be maintained within the range of 5 to 8.5 percent.
4. A Certificate of Compliance shall be furnished with each shipment of precast manhole and catch basin sections stating that the materials furnished have been tested and are in compliance with the specification requirements.
5. The Contractor shall approve the shop drawing submittal for conformance to the specifications and verify existing field conditions, prior to delivery. The Engineers decision to reject the materials not conforming to shall be based on the provisions of this section and is final
6. A protective coating shall be applied by a Licensed or Certified, Coating Contractor to protect all mortared joints around pipe and concrete adjusting rings with 4" overlap on precast. The coating shall conform to the requirements of ASTM D 412. The final liner material shall be made no less than 170 mils thick (brushed) or 80 mils thick (sprayed).

S100.211 Concrete

Concrete used for cast-in-place construction shall be produced and furnished in accordance with the provisions of Mn/DOT Specification 2461 for the mix design indicated in the Plans, Specifications, or Special Provisions. The requirements for Mn/DOT Mix No. 3G52 concrete shall be met where a higher mix design is not specified. Type 3, air-entrained, concrete shall be furnished and used in all structures having weather exposure.

S100.212 Mortar

Mortar for use in masonry construction shall meet the requirements of Mn/DOT 2506.2B and ASTM C270.

S100.213 Trash Guard

Trash guards, where shown on the plan shall have 5/8" (16mm) vertical galvanized steel rods placed 6" (150mm) center to center unless otherwise specified. The guard shall be securely attached to the end section.

S100.214 Riprap

Riprap, where shown on the plans, shall be constructed in accordance with Mn/DOT Section 2511.

Section 3 CONSTRUCTION REQUIREMENTS

S100.301 Notification by Contractor

A. Sanitary Sewer Construction

The discharge of surface water runoff or ground water into the city's sanitary sewer system is strictly prohibited. To protect the sanitary sewers, authorized users, and the treatment works from the accidental discharge of surface water runoff or ground water into the active sanitary sewer the following procedure shall be followed:

1. Two weeks before connecting any new sewer piping to the existing sewer system, the contractor shall notify the Sewer Division of the Department of Public Works as to the schedule of sewer construction activities.
2. The Rochester Sewer Division will install a sewer plug in the outlet of the most downstream manhole through which no sewage is presently passing and that the new sewer will be connected. A plug will be install into each connection to the city's sewer system. In the event that the manhole into which the plug must be installed is a manhole constructed with this project, the Contractor shall notify the Rochester Sewer Division within 24 hours of the installation.
3. After the Rochester Sewer Division has installed the plug, the Contractor may proceed with the Installation of the sewer extension. Upon completion of the work including the cleaning of the sewer lines, air testing the sewer, and conducting the mandrel test, the Contractor shall notify the Rochester Sewer Division. Rochester Sewer Division will televise the public sewer mains. Once all the sewer extension passes all specified tests, the Rochester Sewer Division will remove the sewer plugs.
4. The sewer plugs will be installed by the Rochester Sewer Division and shall be removed by the Sewer Division. The Contractor shall not disturb the plugs.

S100.302 Installation of Pipe and Fittings

A. Inspection and Handling

Proper and adequate implements, tools, and facilities satisfactory to the Engineer shall be provided and used by the Contractor for the safe and convenient prosecution of the work. During the process of unloading, all pipe and accessories shall be inspected by the Contractor for damage. The Contractor shall notify the Engineer of all material found to have cracks, flaws or other defects. The Engineer shall inspect the damaged materials and have the right to reject any materials found to be unsatisfactory. The Contractor shall promptly remove all rejected material from the site. All materials shall be handled carefully, as will prevent damage to protective coatings, linings, and joint fillings; preclude contamination of interior areas; and avoid jolting contact, dropping, or dumping

All work and materials are subject to tests by the City at such frequency as may be determined by the Engineer.

While suspended and before being lowered into laying position, each pipe section and appurtenant unit shall be inspected by the Contractor to detect damage or unsound conditions that may need corrective action or be cause for rejection. The Contractor shall inform the Engineer of any defects discovered and the Engineer will prescribe the required corrective actions or order rejection.

Immediately before placement, the joint surfaces of each pipe section and fitting shall be inspected for the presence of foreign matter, coating blisters, rough edges or projections, and any imperfections so detected shall be corrected by cleaning, trimming, or repair as needed.

B. Pipe Laying Operations

Trench excavation and bedding preparations shall proceed ahead of pipe placement as will permit proper

laying and joining of the units at the prescribed grade and alignment without unnecessary deviation or hindrance.

All foreign matter or dirt shall be removed from the inside of the pipe and fittings before they are lowered into position in the trench and they shall be kept clean by approved means during and after laying. The sewer materials shall be carefully lowered into laying position by the use of suitable restraining devices. Under no circumstances shall the pipe be dropped into the trench.

At the time of pipe placement, the bedding conditions shall be such as to provide uniform and continuous support for the pipe between bell holes. Bell holes shall be excavated as necessary to make the joint connections, but they shall be no larger than would be adequate to support the pipe throughout its length. No pipe material shall be laid in water or when the trench or bedding conditions are otherwise unsuitable or improper.

When placement or handling precautions in the Engineer's opinion prove inadequate, the Contractor shall provide and install suitable plugs or caps effectively closing the open ends of each pipe section before it is lowered into laying position, and they shall remain so covered until removal is necessary for the connection of an adjoining unit.

Unless otherwise permitted by the Engineer, bell and spigot pipe shall be laid with the bell ends facing upgrade and the laying shall start on the downgrade end and proceed upgrade. As each length of bell and spigot pipe is placed in laying position, the spigot end shall be centered in the bell and the pipe forced home and brought to correct line and grade. The pipe shall be secured in place with approved backfill material, which shall be thoroughly compacted by tamping around the pipe to a height of at least 12 inches above the top with hand operated mechanical tamping devices or by hand. The joint areas shall remain exposed and precautions shall be taken to prevent the soil from entering the joint space, until the joint seal is effected. Backfill in the bell area shall be left loose

Connection of pipe to existing lines or previously constructed manholes or catch basins shall be accomplished as shown in the Plans or as otherwise approved by the City. Where necessary to make satisfactory closure or produce the required curvature, grade or alignment deflections at joints shall not exceed that which will assure watertight joints and shall comply with the pipe manufacturer.

Entrance of foreign matter into pipeline openings shall be prevented at all times to the extent that suitable plugs or covering can be kept in place over the openings without interfering with the installation operations.

C. Connection and Assembly of Joints

All pipe and fitting joints shall fit tightly and be fully closed. Spigot ends shall be marked as necessary to indicate the point of complete closure. All joints shall be watertight. Where specified, the joints in certain assemblies shall be made structurally integral by being completely encased in concrete to form a rigid watertight unit as indicated in the standard drawings.

All joints shall be sealed as follows, subject to such other approved method as the City may authorize as being acceptable alternative:

1. Concrete pipe and fitting joints – compression type rubber gasket seals conforming to the requirements of ASTM C443, ASTM C-361 or AASHTO M-198 for circular pipe, or as otherwise approved by the Engineer in the case of non-circular pipe sections.
2. PVC pipe and fittings – assembled gasket seal joints.
3. Corrugated smooth wall PVC pipe and fittings – assembled push-on gasketed joints shall pass performance tests as listed in ASTM D-3212.
4. Corrugated steel pipe and fittings – sealed with Mn/DOT Standard Detail Plate M3221C.
5. Connections to storm sewer mains at other locations than manholes and catch basins shall be made

with precast tees, wyes or junction boxes. Field cut openings may be permitted for mains, which are at least 2 times the size of the branch and no further than 100-ft from a structure. The materials, work and method of connection for other than precast connections shall be subject to the City's approval.

D. Bulkheading Open Pipe Ends

All pipe and fitting ends left open for future connection shall be bulkheaded by approved methods prior to backfilling. Unless otherwise specified or approved, all openings of twenty four inches (24") in diameter or less shall be closed off with prefabricated plugs or caps and all storm sewer openings larger than (24") in diameter shall be closed off with masonry bulkheads.

Prefabricated plugs and caps shall be of the same material as the pipe material, or an approved alternate material, and they shall be installed with watertight seal as required for the pipeline joints. Masonry bulkheads shall be constructed with concrete brick, or solid block to a wall thickness of eight inches (8").

S100.303 Appurtenance Installations

Appurtenance items such as aprons, trash guards, gates and castings shall be installed where and as required by the Plans and in accordance with such standard detail drawings or supplementary requirements as may be specified.

Casting assemblies to be raised or lowered shall follow Mn/DOT Specification 2506.3 with the following modification: the structure construction (excluding casting) above the cone shall not exceed 8 inches.

When the plans call for reconstruction of structures, all debris shall be removed from the bottom of the old structure without additional compensation.

Sewer aprons shall be subject to all applicable requirements for installation of pipe. All aprons and outfall end sections shall be tied as per Mn/DOT Standard Plate 3145.

S100.304 Access to Utilities

At the time any utility is tested, the Contractor shall provide the City access to the manhole. At no time shall the tested utility be inaccessible, either under the pavement or ground.

For new utilities located in the pavement surface, the access shall not be raised until the final pavement surface is applied and then set either ½ inch below the flexible pavement or flush with the rigid pavement.

For utilities not located in the pavement surface, the castings shall be set flush to the final finish grade.

S100.305 Sewer Service Installations

Main sewer service connections and building service sewer pipe shall be installed as provided for in the Contract and as may be directed by the City. The sewer service connections and pipe lines shall be installed in conformance with all applicable requirements of the main sewer installation and as more specifically provided in the City of Rochester standard specification for the construction of service connections.

S100.306 Sanitary Sewer Leakage Testing

All sanitary sewer lines, including service connections, and manholes shall be watertight and shall be tested for excessive leakage upon completion and before connections are made to the service by others.

For gravity flow sewers, the sewer shall be subjected to exfiltration testing, by the ASTM F1417 (low pressure air) test method regardless of pipe material.

For sewers designated as pressure pipe sewers, the sewer shall be subjected to exfiltration testing, by the Minnesota Plumbing Code 4715.2820.

For Manholes, the concrete structure shall be subjected to air testing, by the ASTM C1244 (vacuum) test method.

The requirements set forth for maximum leakage shall be met as a condition for acceptance of the sewer section represented by the test. All testing shall be performed by the Contractor as witnessed by the Engineer without any direct compensation being made therefore, and the Contractor shall furnish all necessary equipment and materials, including plugs as required.

A. Air Test Method-Gravity Sewer

The Table below contains selected text from ASTM F1417 (Gravity Sewer Lines).

3.1 The section of the line to be tested is plugged. Air, at low pressure, is introduced into the plugged line. The line passes the test if the rate of air loss, as measured by pressure drop, does not exceed a specified amount in a specified time. Pressure drop may be determined by using Table 1 or Table 2, or calculated by use of the formulas in 9.1.

TABLE 2 Minimum Specified Time Required for a 0.5 psig Pressure Drop for Size and Length of Pipe Indicated for Q = 0.0015
NOTE-Consult with pipe and appurtenance manufacturer for maximum test pressure for pipe size greater than 30 in. in diameter.

Pipe Diameter, in.	Minimum Time, min : s	Length for Minimum Time, ft	Time for Longer Length, s	Specification Time for Length (L) Shown, min:s								
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft	
4	1:53	597	0.190 L	1:53	1:53	1:53	1:53	1:53	1:53	1:53	1:53	1:53
6	2:50	398	0.427 L	2:50	2:50	2:50	2:50	2:50	2:50	2:50	2:51	3:12
8	3:47	298	0.760 L	3:47	3:47	3:47	3:47	3:48	4:26	5:04	5:42	5:42
10	4:43	239	1.187 L	4:43	4:43	4:43	4:57	5:56	6:55	7:54	8:54	8:54
12	5:40	199	1.709 L	5:40	5:40	5:42	7:08	8:33	9:58	11:24	12:50	12:50
15	7:05	159	2.671 L	7:05	7:05	8:54	11:08	13:21	15:35	17:48	20:02	20:02
18	8:30	133	3.846 L	8:30	9:37	12:49	16:01	19:14	22:26	25:38	28:51	28:51
21	9:55	114	5.235 L	9:55	13:05	17:27	21:49	28:11	30:32	34:54	39:16	39:16
24	11:20	99	6.837 L	11:24	17:57	22:48	28:30	34:11	39:53	45:35	51:17	51:17
27	12:45	88	8.653 L	14:25	21:38	28:51	36:04	43:18	50:30	57:42	64:54	64:54
30	14:10	80	10.683 L	17:48	26:43	35:37	44:31	53:25	62:19	71:13	80:07	80:07
33	15:35	72	12.926 L	21:33	32:19	43:56	53:52	64:38	75:24	86:10	96:57	96:57
36	17:00	66	15.384 L	25:39	38:28	51:17	64:06	76:55	89:44	102:34	115:23	115:23

9.2 Calculate all test times by the following formula:

$$T = 0.085 DK/Q$$
where:
T = shortest time allowed for the air pressure to drop 1.0 psig, s,
K = 0.000419 DL but not less than 1.0,
Q = leak rate in cubic feet/minute/square feet of internal surface = 0.0015 CFM/SF,
D = measured average inside diameter of sewer pipe (see Method D 2122 and Practice D 3567), in., and
L = length of test section, ft.

Table 1 contains the specified minimum times required for a 1.00 psig pressure drop from a starting pressure of 3.5 psig to a final pressure of 2.5 psig using a leakage rate of 0.0015 ft³/min/ft² of internal surface.

B. Air Test Method-Pressure Pipe

The air test shall be made by attaching the air compressor or testing apparatus to any suitable opening and closing all other inlets and outlets to the system by means of proper testing plugs. Air shall be forced into the system until there is a uniform pressure of five (5) psi on the portion of the system being tested. The pressure shall remain constant for 15 minutes without the addition of air.

C. Air Test Method-Manhole

This test applies only for new manholes isolated from connecting sewer lines. The vacuum test shall include testing of the seal between the top of the concrete cone or slab, and the base. If a coating or lining is to be applied to the interior of the manhole the vacuum test must not be performed until the coating or lining has been cured according to the manufacturer's recommendations

The Table below contains selected text from ASTM C1244 Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) test.

1.1 This test method covers procedures for testing precast concrete manhole sections when using the vacuum test method to demonstrate the integrity of the installed materials and the construction procedures. This test method is used for testing concrete manhole sections utilizing mortar, mastic, or gasketed joints.

TABLE 1 Minimum Test Times for Various Manhole Diameters in Seconds

Depth (feet)	Diameter(inches)												
	48	54	60	66	72	78	84	90	96	102	108	114	120
Time (seconds)													
8	20	23	26	29	32	35	41	44	47	50	56	59	62
10	25	29	32	36	40	44	51	55	59	62	70	74	78
12	30	34	39	43	48	53	61	66	70	75	84	89	93
14	35	40	45	51	56	61	71	77	82	87	98	103	109
16	40	46	52	58	64	70	81	87	94	100	112	118	124
18	45	52	58	65	72	79	91	98	105	112	126	133	140
20	50	57	65	72	80	88	102	109	117	125	140	148	156
22	55	63	71	80	88	96	112	120	129	137	154	163	171
24	60	69	78	87	96	105	122	131	141	150	168	177	187
26	65	74	84	94	104	114	132	142	152	162	182	192	202
28	70	80	91	101	112	123	142	153	164	175	196	207	218
30	75	86	97	109	120	131	152	164	176	187	210	222	233

X1.1 The standard accepted method of air testing, for a single diameter pipe, Practice C 924, allows a drop of 1 psi pressure during the time calculated by the formula:

$$T_{\text{Press.}} = \frac{KD^2L}{Q}$$

where: T = time for 1 psi drop in pressure

K = 0.00037 for in./lb units

D = pipe diameter, in.

L = length of line, ft

Q = air loss, ft³/min

7.3 The manhole shall pass if the time for the vacuum reading to drop from 10 in. Hg to 9 in. Hg meets or exceeds the values indicated in Table 1.

D. Test Failure and Remedy

In the event of test failure on any test section, the section shall be replaced, with all repair work subject to approval of the Engineer. The replaced section shall be retested for leakage and deflection in conformance with the specifications contained herein. All repairs, replacement, and retesting shall be at the Contractor's expense.

S100.307 Deflection Test

Deflection tests shall be performed on all gravity sewer pipes. The test shall be conducted after the sewer

trench has been backfilled to the desired finished grade and has been in place for thirty (30) days.

The deflection test shall be performed by pulling a rigid ball or pointed mandrel through the pipe without the aid of mechanical pulling devices. The ball or mandrel shall have a minimum diameter equal to 95.0 % of the actual inside diameter of the pipe. The maximum allowable deflection shall not exceed 5 % of the pipe's internal diameter. The line will be considered acceptable if the mandrel can progress through the line without binding. The time of the test, method of testing, and the equipment to be used for the test shall be subject to the approval of the City.

All testing shall be performed by the Contractor and witnessed by the Engineer at its expense without any direct compensation being made therefore, and the Contractor shall furnish all necessary equipment and materials required.

A. Test Failure and Remedy

In the event of test failure on any test section, the section shall be replaced, with all repair work subject to approval of the City. The replaced section shall be re-tested for leakage and deflection in conformance with the specifications contained herein. All repairs, replacement, and re-testing shall be at the Contractor's expense.

S100.308 Televising

The Contractor and Engineer shall notify the City to televise the lines. The city will televise all lines regardless of visual inspection, leakage testing, or deflection testing prior to use.

Section 4 METHOD OF MEASUREMENT

S100.401 Description

All items will be measured separately according to design designation as indicated in the Pay Item name and as may be detailed and defined in the Plans, Specifications, or Special Provisions. Pipe will generally be designated by size (inside diameter or span); strength class, kind or type, and laying condition. Complete-in-place items shall include all component parts thereof as described or required to complete the unit, but excluding any excesses covered by separate Pay Items. Linear measurement of piping will include the running length of any special fittings (tees, wyes, elbows, gates, etc.) installed within the line of measure between specified terminal points.

S100.402 Sewer Pipe

Sewer pipe of each design designation will be measured by length along the line of pipe. Terminal points of measurement will be the pipe end at free outlets; the point of connection with in-place pipe; the center of manholes or catch basins; the point of centerline intersections at branch fittings; or the point of juncture with other appurtenances or units as defined.

Measurements for trench excavation will be determined separately, when included in the Pay Items for the Plans, and according to the Trench Excavation Specification.

S100.403 Manholes and Catch Basins

Manholes and catch basins of each design will be measured by number of each constructed complete-in-place, including the base and castings as required, for the depth increments as stated in the proposal.

The depth of manholes and catch basins shall be considered as being the distance from the top of the ring, cover, or grate to the invert elevation at the center of the structure.

S100.404 Reconstruct Manholes and Catch Basins

Reconstructed manholes and catch basins will be measured by height from the bottom of the reconstructed portion to the bottom of the ring or frame casting with no regard to type.

Connection of new catch basins to the existing storm sewer piping, including up to 1.5m (5 feet) of new pipe per location, and interconnection of multiple catch basins shall be considered an incidental expense.

S100.405 Adjust Frame and Ring Casting

Adjust frame and ring casting will be measured by the number of castings adjusted, all the castings in any one structure being considered as one assembly.

S100.406 Outside Drop Connection

Outside drop connections of each design will be measured by number of each constructed complete-in-place, including granular encasement, fittings, and any special piping as required, including two holes into existing manhole for the drop connection.

S100.407 Special Pipe Fittings

Special pipe fittings (wyes, tees, bends, waterproofing, etc.) of each design designation will be measured by number of each installed complete-in-place as specified, but excluding any such fittings required to be installed as a component part of any other Work Unit.

S100.408 Appurtenant Items

Appurtenant items such as aprons, trash guards, gates and other prefabricated units or assemblies as identified by Pay Item name will be measured separately by number of each installed complete-in-place as specified.

Section 5 BASIS OF PAYMENT

S100.501 General

Payment for sewer pipe items at the Contract prices of each design shall be compensation in full for all costs of providing a complete-in-place pipeline, including excavation, foundation preparation, bedding, backfilling, leakage testing, plugging, restoration of surface improvements, disposal of surplus or waste materials, final cleanup, and such other work as may be specified, but excluding the construction of other structures or special sections and the placement of special fittings, appurtenances or materials specifically designated for payment under other Contract Items.

Payment for manhole, catch basin, outside drop connection, service connection, and other structures as specified, at the Contract prices per structure, shall be compensation in full for all costs of constructing each unit complete-in-place as specified, including all required castings, special fittings, base or encasement, and appurtenant materials as specified for the complete structure or section, but excluding such additional work as may be designated for payment under other Contract Items.

Special pipe fittings such as wyes, tees and bends will be paid for as separate Contract Items to the extent they are required to be installed in the sewer pipe and service pipe lines and not as a component part of a complete-in-place structure (risers, outside drop connections, service connections, etc.)

Appurtenant items such as aprons, trash guards, drainage gates, and other prefabricated units or assemblies and specials as designated will be paid for as separate Contract Items to the extent they are not included as a component part of any complete-in-place structure.

S100.502 Items List

Payment for construction of Sewer Main will be made on the basis of the following schedule:

ITEM NO	ITEM	UNIT
S100.513	FURNISH & INSTALL CONCRETE INSULATION	CU YD
S100.514	FURNISH & INSTALL __ IN POLYSTYRENE INSULATION	SQ FT
S100.515	CONCRETE ENCASEMENT or CRADLE	CU YD
S100.516	FURNISH & INSTALL __ IN REINFORCED CONCRETE PIPE CLASS __	LIN FT
S100.518	FURNISH & INSTALL __ IN CORRUGATED METAL PIPE	LIN FT
S100.520	FURNISH & INSTALL __ IN ALTERNATE PIPE SEWER	LIN FT
S100.522	FURNISH & INSTALL __ IN ALTERNATE PRESSURE PIPE SEWER	LIN FT
S100.524	FURNISH & INSTALL __ IN PERFORATED PVC PIPE	LIN FT
S100.535	FURNISH & INSTALL __ IN CASING	LIN FT
S100.540	FURNISH & INSTALL __ IN REINFORCED CONCRETE PIPE APRON	EACH
S100.542	FURNISH & INSTALL __ IN CORRUGATED METAL PIPE APRON	EACH
S100.545	CONSTRUCT STRUCTURE TYPE __ (__ IN) __ FT TO __ FT DEEP	STRUCTURE
S100.546	FURNISH & INSTALL CLEANOUT ASSEMBLY	LIN FT
S100.548	FURNISH & INSTALL CASTING ASSEMBLY	EACH
S100.551	FURNISH & INSTALL __ IN X __ IN WYE or TEE	EACH
S100.553	FURNISH & INSTALL __ IN RISER (__) __ FT TO __ FT HIGH	EACH
S100.558	FURNISH & INSTALL __ IN PLUG	EACH
S100.560	FURNISH & INSTALL STOP LOGS or SLIDE GATE	EACH
S100.564	REMOVE _____	EACH
S100.565	SALVAGE _____	EACH
S100.566	ABANDON _____	EACH
S100.567	INSTALL _____	EACH
S100.570	RECONSTRUCT _____	EACH
S100.572	CONNECT INTO EXISTING _____	EACH
S100.574	ADJUST _____	EACH
S150.585	RESTORATION	SQ YD