City of West Linn
Public Works Standard Construction Specifications

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DIVISION THREE – SANITARY SEWER TECHNICAL REQUIREMENTS

301 PIPE AND FITTINGS

301.01 DESCRIPTION

This section covers the following work:

1. Gravity and pressure sewer pipe
2. Fittings
3. Service line sewers

301.02 MATERIALS

301.02.01 General

A. Use all sewer pipe and fittings of the size, strength, material and joint type specified on the Drawings and/or the Proposal. Use jointing material as hereinafter specified for each pipe material. Each piece of pipe shall be clearly identified as to strength, class and date of manufacture.

B. The manufacturer or fabricator shall furnish appropriate certification, based on manufacturer's routine quality control tests, that the materials in the pipe and fittings meet the requirements specified herein. Strength, permeability, hydrostatic tests and pipe joints will be used as the basis of acceptance as described under Proof Tests herein. Minimum length of pipe shall be 3.5 ft.

C. It is not intended that materials listed herein are to be considered equal or generally inter changeable for all applications. The Design Engineer shall determine the materials suitable for the project and so specify.

D. Use pipe and fittings for service lines of one type of material throughout; no interchanging of pipe and fittings will be allowed. Use 4 in. diameter pipe for residential services when not otherwise specified.

E. Do not coat pipes for sewers internally or externally with any substance of any type in an attempt to improve its performance when air tested.

301.02.02 Concrete Pipe

301.02.02.01 Non-Reinforced Concrete Pipe

Non-reinforced concrete pipe shall conform to ASTM C 14, Class 3 as shown or specified and the following additional requirements:

1. Cement shall be Type II conforming to ASTM C 150.
2. The minimum Portland Cement content shall be 564 lbs. per cu. yd.
3. The water/cement ratio shall not exceed 0.49.
4. The Contractor shall provide the City Engineer with a Certificate of Compliance from the pipe manufacturer that the pipe and concrete mix conform in all respects to these specifications and other non-conflicting requirements of the referenced ASTM Specifications.

301.02.02.02 Reinforced Concrete Pipe

Reinforced concrete pipe shall conform to ASTM C 76, Class IV as shown or specified with Wall B design and the following additional requirements:

1. Cement shall be Type II conforming to ASTM C 150.
2. The minimum Portland Cement content shall be 564 lbs. per cu. yd.
3. The water/cement ratio shall not exceed 0.49.
4. Elliptical reinforcing is not permitted.
5. The area of the outer circular reinforcing cage shall not be less than 75% by the inner cage.
6. The Contractor shall provide the City Engineer with a Certificate of Compliance from the pipe manufacturer that the pipe and concrete mix conform in all respects to these specifications and other non-conflicting requirements of the referenced ASTM Specifications.

301.02.03 Ductile Iron Pipe

A. Ductile iron pipe centrifugally cast of 60-42-10 iron shall conform to ANSI A21.51 Class 150 or AWWA C151, with Push-on Joint or Mechanical Joints as specified, conforming to ANSI Specification A21.11/AWWA C111. Ductile iron pipe shall be lined with cement mortar and seal coated in accordance with ANSI Standard A21.4/AWWA C104.

B. When specified, tube type polyethylene encasement shall conform to ANSI A21.5/AWWA C105.

301.02.04 PVC Non-Pressure Pipe

PVC sewer pipe shall conform to ASTM D 3034 SDR-35.

301.02.05 PVC Pressure Pipe

PVC pressure pipe shall conform to AWWA C900 class as specified.

301.02.06 Service Connection Markers

New 2 in. x 4 in. utility grade lumber, or better, in one piece shall be used. No splicing will be permitted.

301.02.07 Jointing Materials

A. Only lubricants for jointing materials approved by the manufacturer shall be used.

B. Furnish in duplicate a certified statement from the manufacturer of the gaskets, setting forth the basic polymer used in the gaskets and results of the tests of the physical properties of the compound. Gaskets shall be shipped in containers with identification of the batch from which the gaskets were fabricated.

301.02.07.01 Concrete Pipe

All pipes shall be bell and spigot. Rubber gaskets for bell and spigot pipe shall conform to ASTM C 443. Use captive gasket in groove design for pipe 24 in. diameter and larger.

301.02.07.02 Cast Iron and Ductile Iron Pipe

Rubber gaskets shall conform to ANSI A21.11/AWWA C111.

301.02.07.03 PVC Pipe

Rubber gaskets for PVC pipe shall conform to ASTM F 477.

301.02.08 Proof Tests

301.02.08.01 General

The intent of this requirement is to prequalify a joint system, components of which meet the joint requirements, as to the water tightness capability of that joint system. This proof test shall be understood to apply to all sanitary sewers. Material and test equipment for proof testing shall be provided by the manufacturer. Joints shall meet the requirements of yard testing specified below. The pipe manufacturer shall submit results of the yard tests made, certified by a testing agency acceptable to the City Engineer. In general, each pipe material and joint assembly shall be subject to the following three proof tests at the discretion of the City Engineer:

1. Pipe in Straight Alignment - No less than three nor more than five pipes selected from stock by the City Engineer or the testing agency shall be assembled according to the manufacturer's installation instructions with the ends suitable plugged and restrained against internal pressure. The pipe shall be subjected to 13 psi hydrostatic pressure for 10 minutes. Free movement of water through the pipe joint or pipe shall be grounds for rejection of the pipe.
2. Pipe in Maximum Deflected Position - A test section shall be deflected as described hereinafter for each pipe material. The pipe shall be subjected to 10 psi hydrostatic pressure for 10 minutes. Free movement of water through the pipe joint or pipe wall shall be grounds for rejection of the pipe.
3. Joints Under Differential Load - The test section shall be supported on blocks or otherwise as described hereinafter for each pipe material. There shall be no visible leakage when the stressed joint is subjected to 10 psi internal hydrostatic pressure for 10 minutes.

301.02.08.02 Concrete Pipe

A. For deflected position, create a position 1/2 in. wider than the fully assembled position, on one side of the outside perimeter of each joint.

B. For differential load test, assemble three pipes according to the manufacturer's instructions in straight alignment with the ends suitably plugged and restrained against internal hydrostatic pressure. The end pipes of the test section shall be supported on blocks or otherwise so that the center pipe is suspended freely between the adjacent pipe and bearing only the joints. T

C. he pipe section shall be filled with water and a load of 150 pounds per inch of pipe diameter, in addition to the weight of the pipe, shall be supplied over an arc of not less than 120° along a longitudinal distance of 12 in. immediately adjacent to one of the joints. For pipe 24 in. and larger, the applied load shall be reduced by 1/2 of the weight of water in the suspended pipe.

301.02.08.03 Cast Iron Pipe and Ductile Iron Pipe

A. For deflected position, create a position 1/2 in. wider than the fully compressed section on one side of the outside perimeter.

B. For differential load, support so that one of the pipes is suspended freely between adjacent pipe, bearing only on the joints. Apply a force per the following table along a longitudinal distance of 12 in., immediately adjacent to one of the joints.

Pipe Size	Force – Pounds	Pipe Size	Force – Pounds
4 in.	1,000	15 in.	3,700
6 in.	1,500	18 in.	4,400
8 in.	2,000	21 in.	5,000
10 in.	2,500	24 in.	5,500
12 in.	3,000	and over	----

301.01.08D PVC Pipe

PVC pipe joints shall be tested by and meet the requirement of ASTM C 3212 for gravity sewers and ASTM D 3139 for pressure sewers.

301.02.09 Fittings

301.02.09.01 General

A. Provide tee or wye fittings in the sewer main for service line sewers and catch basin or inlet connections. Tee and wyes for service line sewers shall be 4 in. inside diameter, unless otherwise specified. All fittings shall be of sufficient strength to withstand all handling and load stresses encountered.

B. All fittings shall be of the same materials as the pipe unless otherwise specified. Material joining the fittings to the pipe shall be free from cracks and shall adhere tightly to each joining surface. Use the same type of joints on all fittings that are used on the main sewer pipe. Tee or wye fittings shall not be closer than 12 in. to any joint or bell of main line sewer which is 12 in. or less in diameter.

301.02.09.02 Concrete Pipe

A. Use shop fabricated fittings on all concrete pipe.

B. Submit fabrication details for shop fabricated fittings for review prior to delivery of fittings to the job site.

301.02.09.03 Cast Iron and Ductile Pipe

Use mechanical joint cast iron fittings conforming to ANSI A21.10/AWWA C110, and a class of at least equal to that of the adjacent pipe. Use push-on fittings of gray cast iron with body thickness and radii of curvature conforming to ANSI A21.10 and joints conforming to ANSI A21.11/AWWA C111.

301.02.09.04 PVC Pipe

A. PVC pipe shall be connected to sanitary manholes using an approved adapter specifically manufactured for the intended service and approved by the City Engineer. PVC pipe adapters shall be Fernco CMA, Romac LCT, Tylox Manhole Adapters, Vassalo Series 32850, Kor-N-Seal, Sealtite, Z-Lok-XP, or equal commercial product. Field-fabricated waterstops or improvised adapters such as gaskets stretched over the pipe will not be allowed.

B. Adapters requiring the use of grout for installation shall be anchored and finished using an approved non-shrink grout. Mortar is not acceptable.

301.02.10 Pipe Coupling Adapters

Use flexible mechanical compression joint coupling with No. 305 stainless steel bands manufactured by Joints, Inc., Fernco Joint Sealer, or equal.

301.02.11 Cleanouts

Cleanouts will be of the same material and size as the main line.

301.03 CONSTRUCTION

301.03.01 Excavation and Backfill

Conform to the requirements of **Section 204, EXCAVATION, EMBANKMENT, BEDDING, AND BACKFILL**. All excavation shall be unclassified.

301.03.02 Line and Grade for Gravity and Pressure Sewers

Do not deviate from line or grade, as established by the Design Engineer, more than 1/2 in. for line and 1/4 in. for grade, provided that such variation does not result in a level or reverse sloping invert. Measure for grade at the pipe invert, not at the top of the pipe because of permissible variation in pipe wall thickness. Establish line and grade for pipe by the use of lasers or by transferring the cut from the offset stakes to batter boards at maximum intervals of 25 ft.

301.03.02.01 Line and Grade for Service Line Sewers

A. The Design Engineer will establish line and grade to the tract of land to be serviced by the sewer system. At the preselected location of the service line, a stake will be driven into the ground showing the depth of excavation required at the property line.

B. Lay the pipe on a straight line and at a 2% grade between the tee or riser and the stake. Lay the pipe by means of a builder's level of good quality and not less than 24 in. in length.

301.03.03 Pipe Distribution and Handling

A. Distribute material on the job no faster than it can be used to good advantage. Unload pipe only by means recommended by the pipe manufacturer. Do not unload pipe of any size by dropping to the ground. Do not distribute more than one week's supply of material in advance of laying, unless approved.

B. Pipe shall not be unloaded or stored in the public right-of-way or easement unless it has been certified and accepted by the Design Engineer. Inspect all pipe and fittings prior to lowering into trench to ensure no cracked, broken, or otherwise defective materials are used. Clean ends of pipe thoroughly. Remove foreign matter and dirt from inside of pipe and keep clean during and after laying.

C. Use proper implements, tools, and facilities for the safe and proper protection of the work. Lower pipe into the trench in such a manner as to avoid any physical damage to the pipe. Remove all damaged pipe from the job site. Do not drop or dump pipe into trenches.

301.03.04 Pipe Laying and Jointing of Pipe and Fittings

301.03.04.01 General

A. Proceed with pipe laying upgrade with spigot or tongue ends pointing in direction of flow. Place pipe in such a manner as to ensure a continuous and uniform bearing and support for the full length of the pipe between joints. Take care to properly align the pipe before forced entirely home.

B. Upon completion of pipe laying all pipe joints shall be in the "home" position, which is defined as the position where the least gap (if any) exists, when the pipe components that comprise the join are fitted together as tightly as the approved joint design will permit. Gaps at pipe joints shall not exceed that allowed by the manufacturer's recommendations.

C. Take special care to prevent movement of the pipe after installation when laid within a movable trench shield.

D. When laying operations are not in progress, protect the open end of the pipe from entry of foreign material and block the pipe to prevent movement or creep of gasketed joints.

E. Plug or close off pipes which are stubbed out for manhole construction or for connection by others.

F. Provide all sewer pipes, 36 in. or smaller in diameter, entering or leaving manholes or other structures, with flexible joints within 18 in. of the exterior wall. Pipes larger than 36 in. in diameter shall have this flexible joint within a distance from the exterior wall equal to one-half the inside pipe diameter.

G. When cutting and/or machining the pipe is necessary, use only tools and methods recommended by pipe manufacturer.

H. When shown or approved to deflect pipe from a straight line, either in the vertical or horizontal plan, or when long-radius curves are shown, the amount of deflection shall not exceed that specified or approved by the City Engineer. The pipe manufacturer's recommendation will serve as a guide, but the decision of the City Engineer shall be final.

301.03.04.02 Concrete Pipe

Use rubber ring gasket joints.

301.03.05 Installation of Service Line Sewers, Tees and Wyes

A. Install tee and wye fittings and service line sewers as shown in standard drawings. Provide pipe bedding material compacted to a minimum of 90% of maximum density as determined by ASTM D 1557/AASHTO T-180 under all tees and wyes and branch fittings, extending to the springline of the fittings. Place pipe bedding material on undisturbed native material or compacted foundation stabilization material.

B. Connect service lines to manholes only when directed. Make the connection so the standard pipe joint is located not more than 1.5 ft. from the structure.

C. Provide ends of all service lines and fittings with approved watertight plugs, caps, or stoppers, suitably braced to prevent blowoff during internal air testing. Such plugs or caps shall be removable and their removal shall provide a socket suitable for making a flexible joint lateral connection or extension.

301.03.06 Markers

A. In new subdivisions, undeveloped areas, and where connections will not be made in the contract, after the service line is installed, block the capped or plugged end and install 2 in. x 4 in. marker. Extend markers at least 4 ft. above the ground surface. Paint the top portion of the marker after its installation with first-quality green, quick-drying enamel. After the paint has dried, use black, quick-drying enamel and neatly indicate the distance from the natural ground surface to the top of the service line pipe in feet and inches.

B. Take precautions during the backfilling operation to ensure the position and location of the marker. If the marker is broken or knocked out of vertical alignment during the backfilling operation, reopen the trench and replace the marker.

301.03.07 Concrete Closure Collars

A. Only where specified on Drawings, construct concrete closure collars in conformance with the details provided. Wash pipe to remove all loose material and soil from the surface on which the concrete will be placed. Construct forms with materials that will ensure that no concrete shall enter the line. Make entire collar in one placement, and do not place collars in water. Concrete closure collars shall be placed using an approved commercial concrete bonding agent applied to all surfaces in contact with the collar.

B. Where concrete closure collars are necessary to join PVC pipe, the PVC surface shall first be prepared for bonding to the concrete by applying a dense coating of clean mortar sand to the pipe using PVC solvent cement. After the cement has cured, commercial concrete bonding agent shall be applied to the sand surface prior to placement of concrete. Water as a substitute for commercial bonding agent will not be allowed. Do not backfill the trench until the concrete has sufficient strength.

301.03.08 Disconnection and Reconnection of Existing Service Lines

When shown or directed, disconnect existing service lines from existing sewers and reconnect them to the new sewers. The Contractor shall be responsible for locating the existing service lines prior to installing the tee or wye in the new sewer line. The contractor shall verify and reconnect all active services to the main line sewer.

301.03.09 Testing

301.03.09.01 General

A. All gravity sanitary sewers including service line sewers and appurtenances shall successfully pass an air test prior to acceptance and shall be free of leakage. Manholes shall be tested as specified in **Section 302, MANHOLES AND CONCRETE STRUCTURES**.

B. All pressure sewer force mains shall be tested in accordance with applicable portions of **Section 403**, **CONSTRUCTION** when not otherwise specified.

C. A televised inspection of the sanitary sewer pipe shall be performed. Any defects in material or workmanship shall be satisfactorily corrected prior to final acceptance of the work.

D. All tests and inspections (including video-inspection) must be performed in the presence of the City Engineer or his/her representative to be valid.

E. Tests shall be performed in the following order: deflection testing, air pressure testing, video inspection. If any one of the tests fail, all tests must be completed again after repair of the failed section in the testing order specified above.

F. Deflection testing, air pressure testing, and video inspection shall be done only after backfill has passed the required compaction tests based on AASHTO T-180 and the roadway base rock has been placed, compacted, and approved by the City Engineer.

G. The sanitary system must receive the approval of the City Engineer regarding deflection testing, air pressure testing, and video inspection before paving of overlying roadways will be permitted.

301.03.09.02 Cleaning Prior to Testing and Acceptance

A. Prior to final testing, acceptance and final manhole-to-manhole inspection of the sewer system by the City Engineer, ball, flush and clean all parts of the system. Remove all accumulated construction debris, rocks, gravel, sand silt, and other foreign material from the sewer system at or near the closest downstream manhole. If necessary, use hydrocleaning.

B. Upon the City Engineer's final manhole-to-manhole inspection of the sewer system, if any foreign matter is still present in the system, reflush and clean the sections and portions of the lines as required.

301.03.09.03 Testing Procedure

Perform the tests in a manner satisfactory to the City Engineer. Any arrangement of testing equipment which will provide observable and accurate measurements of air leakage under the specified conditions will be permitted. Calibrate gauges for air testing with a standardized test gauge provided by the Contractor at the start of each testing day. The calibration shall be witnessed by the City Engineer; notify the City Engineer 24 hours prior to each test.

301.03.09.04 Time of Test

Make tests of sections of constructed sanitary sewer for acceptance only after all service connections, manholes, backfilling, and compaction are completed between the stations to be tested. Owner may require testing of manhole-to-manhole sections as they are completed in order to expedite the acceptance of sections of sewer and allow connections prior to the whole system being completed.

301.03.09.05 Repairs

A. Repair or replace, in a manner satisfactory to the City Engineer, any section of the system not meeting the air test requirements, or which has leakage or infiltration.

B. Correct such failures occurring within the warranty period in a manner satisfactory to the City Engineer at the Contractor's sole expense.

C. The Contractor, in contracting to do this work, agrees that the leakage allowances as indicated herein are fair and practical.

301.03.09.06 Air Testing

A. General

1. The City Engineer may, at any time, require a calibration check of the instrumentation used. Use a pressure gauge having minimum divisions of 0.10 psi and an accuracy of 0.0625 psi. (1 oz. per sq. in.) All air used shall pass through a single control panel.

2. All plugs used to close the sewer for the air test must be capable of resisting the internal pressures and must be securely braced. Place all air testing equipment above ground and allow no one to enter a manhole or trench where a plugged sewer is under pressure. Release all pressure before the plugs are removed.

3. The testing equipment used must include a pressure relief device designed to relieve pressure in the sewer under test at 10 psi or less and must allow continuous monitoring of the test pressures in order to avoid excessive pressure. Use care to avoid the flooding of the air inlet by infiltrated ground water. (Inject the air at the upper plug if possible.) Use only qualified personnel to conduct the test.

B. Ground Water

1. The presence of ground water will affect the results of the test. Determine the average height of ground water over the sewer immediately before starting the test.

2. In every case, determine the height of the water table at the time of the test by exploratory holes or such other methods satisfactory to the City Engineer. The City Engineer will make the final decisions regarding test height for the water in the pipe section being tested.

C. Method

Use the Time-Pressure Drop Method for all air testing. The test procedures are described as follows:

a. Clean the sewer to be tested and remove all debris where noted.

b. Wet the sewer prior to testing, if desirable.

c. Plug all sewer outlets with suitable test plugs. Brace each plug securely.

d. Check the average height of the ground water over the sewer. The test pressures required below shall be increased 0.433 psi for each foot of average water depth over the sewer.

e. Add air slowly to the section of sewer being tested until the internal air pressure is raised to 4.0 psig greater than the average back pressure of any ground water that may submerge the pipe.

f. After the internal test pressure is reached, allow at least 2 minutes for the air temperature to stabilize, adding only the amount of air required to maintain pressure.

g. After the temperature stabilization period, disconnect the air supply.

h. Determine and record the time in seconds that is required for the internal air pressure to drop from 3.5 psig to 2.5 psig greater than the average back pressure of any ground water that may submerge the pipe. This leakage only allowed in concrete pipe. For PVC and ductile iron pipe, no leakage allowed.

D. Acceptance

1. The sewer shall be considered acceptable when tested as described previously if the section under test does not lose air at a rate greater than 0.0015 cfm per sq. ft. of internal sewer surface. This leakage only allowed in concrete pipe. For PVC and ductile iron pipe, no leakage allowed.

2. For test sections containing over 625 sq. ft. of surface area, the time measured by this method for 1.0 psi pressure drop shall be calculated according to the formula below.

$T = d^2L/42$	T = test duration, seconds
	d = pipe diameter (inches)
	L = section length (feet)
	42 = conversion factor

3. For test sections containing less than 625 sq. ft. of internal surface area, the time measured by this method for 1.0 psi pressure drop shall be calculated according to the formula below.

$T = 56d$	T = test duration, seconds
	d = pipe diameter (inches)

4. The internal surface area of pipeline sections may be calculated using the formula below.

$A = \pi Ld/12$	A = area in square feet
	π = constant (3.14)
	d = pipe inside diameter (inches)
	L = pipe length (feet)

5. The surface areas of lateral lines of differing lengths and diameters may be accommodated in Equations 1 and 2 above by using the sums $(d_1)^2L_1 + ... + (dn)^2Ln$ and $d_1 + ... + dn$ in place of d^2L and d, respectively.

301.03.10 Deflection Test for PVC Pipe

A. In addition to air testing, perform a deflection test for all sanitary sewers and culverts constructed of PVC pipe after the trench backfill and compaction has been completed. The test shall be conducted by pulling an approved solid pointed mandrel or variable deflection measuring gauge through the completed pipeline a minimum of 30 days after compaction is completed. The diameter of the mandrel shall be 95% of the internal pipe diameter.

B. Conduct testing on a manhole-to-manhole basis and only after the line has been completely flushed clean with water. Locate and repair any sections failing to pass the test and retest the section, at the Contractor's sole expense.

301.03.11 Television Inspection of Sanitary Sewers

A. Upon completion of all sewer construction, repairs, cleaning, and required tests, the contractor shall notify the City Engineer when the television inspection will be performed.

B. Subsequent to being notified, the City Engineer shall commence examination of lines. Findings will be recorded. Use pan & tilt camera types only and every lateral shall be inspected and identified on tape.

C. When performing television inspections, water shall be added, tracing dye and a 1 in. measuring ball shall be utilized.

D. Upon correction of deficiencies revealed by televiewing, the contractor shall notify the City Engineer; the same steps listed above may be repeated until all work is acceptable.

E. Air tests and deflection tests are required prior to television inspection. All tests and inspections must be done in the presence of the City Engineer or his/her authorized representative.

F. Before release of the maintenance or warranty bond, the City Engineer may require televised inspection of the piping at the Contractor's expense. The Contractor shall correct all deficiencies found by this inspection.

G. The City of West Linn may, at its own option, perform a deflection test.

301.03.12 Subsequent Failure

No infiltration of ground water in the system is allowed. No standing water is allowed.

301.03.13 Cleanouts

Cleanouts will be constructed per the City Standard Details. The cleanout will stand vertical and the Contractor will bring compacted bedding material up around the vertical portion to the top.

301.03.14 Service Risers

The service risers will be constructed with a tee fitting at the main line. If a wye fitting is necessary then a 1/8 bend will be utilized at the wye in place of the tee. Payment will begin at the upper end of the 1/8 bend if the Contractor chooses to use this method.

302 MANHOLES AND CONCRETE STRUCTURES

302.01 DESCRIPTION

This section covers the work necessary for the construction of the following items:

1. Manholes
4. Drop Assemblies
5. Special Concrete Structures
6. Concrete Encasement

302.02 MATERIALS

302.02.01 Base Rock

Three-quarter inch minus base rock, conforming to the requirements for crushed aggregate material in ***Subsection 204.02.06, Class B Backfill, 3/4"-0 Crushed Aggregate.***

302.02.02 Forms

Forms for exposed surfaces shall be steel or plywood. Others shall be matched boards, plywood or other approved material. Form all vertical surfaces. Trench walls, large rock or earth shall not be used as form material.

302.02.03 Concrete and Reinforced Steel

Concrete and reinforcing steel shall conform to **Section 205, TYPES AND USE OF MATERIALS.**

302.02.04 Cement Mortar

When specified for use, cement mortar shall conform to **Section 205, TYPES AND USE OF MATERIALS**. Consistency of mortar shall be such that it will readily adhere to the pipe if using the standard tongue-and-groove type joint. Mortar mixed for longer than 30 minutes shall not be used.

302.02.05 Manholes

302.02.05.01 Standard Precast Manhole Sections

A. Furnish sections as specified conforming to the details on the Standard Drawings and to ASTM C 478. Cones shall have same wall thickness and reinforcement as manhole section. Provide eccentric cones with precast grooves for all manholes over 6 ft. in depth. Flat slab tops with precast grooves reinforced to withstand AASHTO H 20 loading shall be provided for manholes 4 ft. deep from crown of pipe and less. Top and bottom of all sections shall be parallel.

B. Prior to the delivery of any size of precast manhole section on the job site, yard permeability tests will be conducted at the point of manufacture. The precast sections to be tested will be selected at random from the stockpiled material which is to be supplied for the job. All test specimens will be mat tested, and shall meet the permeability test requirements of ASTM C 4 and ASTM C 497.

302.02.05.02 Precast Concrete Bases

Manholes may be constructed using precast, reinforced concrete bases. Construction of precast bases shall conform to the requirements of ASTM C 478. THE BASE RISER SECTION SHALL BE INTEGRAL WITH THE BASE SLAB.

302.02.05.03 Poured in Place Manhole Bases

The Contractor may use poured in place manhole bases. Concrete shall conform to **Section 302, MANHOLES AND CONCRETE STRUCTURES**.

302.02.05.04 Manhole Grade Rings

Concrete grade rings for extensions shall be a maximum of 6 in. high.

302.02.05.05 Jointing Materials

Preformed plastic gaskets conforming to the requirements of AASHTO M-198 or joints using confined O-ring with rubber gaskets conforming to ASTM C 443 shall be used.

302.02.06 Pipe and Fittings

Conform to requirements of **Section 301, PIPE AND FITTINGS.**

302.02.07 Manhole and Cleanout Frames and Covers

302.02.07.01 General

A. All castings shall be true to size, weight and tolerances shown on the Standard Drawings. Delivered weight shall be +/- 5 percent of the specified weight. The bearing seat shall not rock when checked by the test jig. The foundry shall supply all test gauges and shall not subcontract any of the work other than testing procedure, patterns, and machining and cartage.

B. The casting shall not be made by the open mold method and shall be free of porosity, shrink cavities, cold shuts, or cracks, or any defects which would impair serviceability. Repair of defects by welding or by the use of "smooth-on" or similar material will not be permitted.

C. All castings shall be shot or sandblasted, and the application of paint or other coating will not be permitted. All manhole frames and covers located outside of the right-of-way shall be tamper-proof.

302.02.07.02 Materials

A. Conform to ASTM A 48, Class 30B with the following revisions:

Tensile Strength	30,000 psi
Traverse Strength:	1.2 in. diam. bar at 18 in. centers
Load - Pounds	2,600 - 3,000
Deflection - Inches	0.22 - 0.34
Brinell Hardness (as cast)	173 - 200

B. The foundry shall certify as to the tensile and traverse properties and the Brinell Hardness. The Owner reserves the right to require a Rough Transverse bar (size of bar 1.2 in. diam. by 20 in. long) and/or a tensile bar as per ASTM A 48 for each 20 castings or heat when less than 20 castings are made.

302.02.07.03 Inspection

A. Notify the Owner at least 24 hours in advance of casting the units or bars. At least 24 hours notice shall also be given prior to final gauging and inspection.

B. When directed, the following strength test shall be made on the manhole cover. The cover, while resting it its frame, shall sustain a concentrated load of 40,000 lbs. applied at its center through a 2-1/2 in. plug. The City Engineer may, at any time, require up to 5% of the job and/or order and in no case less than one cover to be tested in this manner.

C. In case of failure during the test, additional covers shall be furnished until the tests prove satisfactory. Covers that do not pass this test shall not be used.

302.02.07.04 Cap Screws

Cap screws and washers for tamperproof and watertight manhole covers shall be stainless steel with 60,000 psi minimum tensile strength conforming to ASTM A 453.

302.02.08 Steps for Precast Manholes

A. Steps for precast manholes shall be of 3/4 in. diameter structural steel in conformance with the Standard Details or be of steel reinforced polypropylene plastic, M.A. Industries, Inc., No PS-2PFS, or Lane No. P-13850, or approved equal. All steps shall be in conformance with ASTM C 478 and shall be aligned vertically. All steps within a manhole shall be of the same design, type and size (mixing of unmatched steps

within the same manhole is not permitted). Loose steps shall be cause for rejection of that manhole cone or section.

B. Steps of 3/4 in. diameter structural steel shall conform to ASTM A 36 and galvanized in accordance to ASTM A 123. Steps shall be safety type 12 in. x 8 in. x 2 in. pattern as shown on the Standard Plans.

C. Steel reinforced polypropylene steps are to be driven into pre-formed holes in precast concrete manhole cones and sections by the manhole manufacturer prior to delivery to job site and shall be in conformance with specifications indicated below:

1. ASTM A 615 Grade 60, 1/2 in. deformed steel rod
2. ASTM 2146 78 Type II, Polypropylene

302.02.09 Non-Shrink Grout

A. Non-shrink grout shall be Sika 212, Euco N-S, Five-Star, or equal non-metallic cementitious commercial grout exhibiting zero shrinkage per ASTM C 827 and CRD-C-621. Grout shall not be amended with cement or sand, and shall not be reconditioned with water after initial mixing. Unused grout shall be discarded after 20 minutes and shall not be used.

B. Non-shrink grouts shall be placed or packed only with the use of an approved commercial concrete bonding agent applied to all cured concrete surfaces being grouted. The bonding agent shall be compatible with the brand of grout being used. Water as a substitute for commercial bonding agent for non-shrink grout will not be allowed in sanitary sewer construction.

302.03 CONSTRUCTION

302.03.01 General

302.03.01.01 Excavation and Backfill

Conform to applicable provisions in **Section 204, EXCAVATION, EMBANKMENT, BEDDING, AND BACKFILL.** Backfill around manholes, inlets, catch basins, and other appurtenances shall be of the same quality as the trench backfill immediately adjacent. All excavation shall be unclassified.

302.03.01.02 Base Rock

Place crushed aggregate base rock and thoroughly compact with a mechanical vibrating or power tamper.

302.03.01.03 Foundation Stabilization

If material in bottom of excavation is unsuitable for supporting manholes and other sewer appurtenances, excavate below subgrade as directed and backfill to required grade with rock conforming to Foundation Stabilization in **Section 204, EXCAVATION, EMBANKMENT, BEDDING, AND BACKFILL**.

302.03.02 Manholes

A. All manholes, except as otherwise specified, shall be constructed using precast, reinforced concrete base sections, riser sections, and other precast appurtenances conforming to ASTM C 478. Base riser sections shall be integral with the base slabs.

B. Preformed plastic gaskets shall be installed in strict accordance with the manufacturer's recommendation. Only pipe primer furnished by the gasket manufacturer will be approved. When using preformed plastic gaskets, manhole sections with chips or cracks in the joint surfaces shall not be used. Completed manholes shall be rigid and all manholes for sanitary sewers shall pass the vacuum test. Construct manhole inverts in conformance with the Standard Drawings with smooth transitions to ensure an unobstructed flow through manhole. Cover exposed edges of pipe completely with mortar. Trowel all mortar surfaces smooth.

C. The inside of all manholes will be grouted smooth with all spaces between risers, rings, and cones filled with grout flush with the inside of the manhole.

D. Holes for installing pipe into precast manhole sections shall be cast in place or core drilled.

E. Channels shall conform accurately to sewer grade. Channel shall be formed to accept a 3 ft. long by 6 in. TV camera. Construct cast in place channel and shelf, in field, in one operation. Finish concrete shelf between channels with a brush.

302.03.03 Drop Assemblies

Construct drop assemblies at locations indicated and as shown on the Standard Drawings.

302.03.04 Pipe Stubouts and Manholes

Install stubouts from manholes at locations as shown or directed. Concrete pipe connections to sanitary manholes shall be grouted watertight with non-shrink grout using an approved commercial concrete bonding agent applied to all concrete surfaces being grouted. Provide manhole with resilient connector for PVC pipe connectors. Core drill opening in manhole walls with concrete saw. Pipe connections to the cone section of a manhole are strictly prohibited.

302.03.05 Manhole Grade Rings

A. In general, manhole grade rings will be used on all manholes in streets or roads or other locations where a subsequent change in existing grade may take place. Extensions will be limited to a maximum height of 12 in.

B. Install appropriate combination of grade rings to a height that will accommodate the finish manhole surface elevation as shown on the Drawings. Lay grade rings in mortar with sides plumb and tops level. All mortared sanitary sewer manhole necks and all grade ring joints made with mortar shall be constructed using an approved commercial concrete bonding agent applied to all cured concrete surfaces being mortared.

C. No joints, necks, frames, or grade rings on sanitary sewers shall be mortared without an approved bonding agent. Water as a substitute for commercial concrete bonding agent will not be approved. Grade ring extensions shall be watertight.

302.03.06 Adjustment of Manholes and Cleanouts to Grade

A. Frame and cover shall be brought up to finish grade for asphaltic concrete. If only one lift of AC will be applied for a period of time exceeding 24 hours prior to second lift, the frame and cover shall be brought to the grade of the first lift, and standard cast iron riser rings shall be used to adjust grade at a later date for final lift. (Resolution 05-10 4/11/05)

B. All storm manholes located outside of paved areas shall be raised 12 in. above final grade and tamper proof frames and lids shall be used. (Resolution 05-10 4/11/05)

302.03.07 Vacuum Testing

Manholes shall be vacuum tested.

1. Each manhole may be tested immediately after assembly and prior to backfilling for contractor information and ease of repair if necessary. Acceptance testing will be accomplished after backfilling and final paving is complete.

2. All lift holes shall be plugged with an approved non-shrink grout. Manhole frame to grade ring or cone connection shall use commercial concrete bonding agent and non-shrink grout.

3. All pipes entering the manhole shall be plugged, taking care to securely brace the plug from being drawn into the manhole.

4. The test head shall be placed at the inside of the top of the manhole frame and the seal inflated in accordance with the manufacturer's recommendations. The seal at grade rings and frame shall be subject to the test.

5. A vacuum of 10 in. of mercury shall be drawn and the vacuum pump shut off. With valves closed, the time shall be measured for the vacuum to drop to 9 in. The manhole shall pass if the time is greater than 60 seconds for 48 in. diameter, 75 seconds for 60 in., and 90 seconds for 72 in. diameter manholes.

6. If the manhole fails the initial test, necessary repairs shall be made with an approved non-shrink, quick-setting grout. Retesting shall proceed until a satisfactory test is obtained.

302.03.08 Concrete Encasement for Sanitary Sewer

A. Conform to the requirements shown on the Standard Drawings and to applicable requirements of **Section 204, EXCAVATION, EMBANKMENT, BEDDING, AND BACKFILL**. Foundation stabilization, if required, shall be completed and the bottom of the trench compacted. Sides of encasement shall be formed, not poured against soil or rock, unless directed or approved by the City Engineer.

B. Support pipe true to line and grade before and during placement of concrete. Encasement shall be placed in a minimum of two lifts. Provide a keyway on both sides of the encased pipe and vertical reinforcing bond steel as shown on Standard Drawings. Adequately support the pipe to prevent pipe deflection during concrete placement and initial set.

C. Reinforcing shall be placed as shown on the appropriate Standard Detail.

D. After concrete encasement has been placed and taken an initial set, cure by covering with well-moistened earth or backfill material for five days before conducting compaction operations and air test.

302.03.09 Special Concrete Structures

Conform to the details as shown.

302.03.10 Placing Precast Units

If material in bottom of trench is unsuitable for supporting unit, excavate as directed and backfill to required grade with foundation stabilization material in conformance with **Section 204, EXCAVATION, EMBANKMENT, BEDDING, AND BACKFILL**. Set units to grade at locations shown or directed.

302.03.11 Cleaning

Upon completion, clean each structure of all silt, debris and foreign matter.

303 WORK ON EXISTING SANITARY SEWERS

303.01 DESCRIPTION

This section covers the work necessary to join new work to existing, the abandoning of sanitary sewer lines, storm drains and structures, and adjusting existing utility structures to finished grades.

303.02 MATERIALS

Conform to requirements of **Section 205, TYPES AND USE OF MATERIALS** and to the requirements for related work referred to herein.

303.02.01 Prefabricated Inside Drops (Oregon Drops)

This type of connection will only be allowed with prior approval by the City Engineer. Materials proposed to be used in construction shall be submitted to the City Engineer for approval.

303.03 CONSTRUCTION

303.03.01 Excavation and Backfill

Conform to requirements of **Section 204, EXCAVATION, EMBANKMENT, BEDDING, AND BACKFILL**. All excavation shall be unclassified.

303.03.02 Manholes Over Existing Sewers

A. Advise City Engineer of system for diverting sewage flow and obtain authorization before starting. The Contractor shall be totally responsible for maintaining adequate capacity for flow at all times and adequately protecting new and existing work.

B. Construct manholes over existing operating sewer lines at locations shown. Perform necessary excavation and construct new manholes in conformance with applicable requirements of **Section 302, MANHOLES AND CONCRETE STRUCTURES**.

C. Construct manholes as shown on the Detail Drawings or Standard Drawings. Densify the concrete base by vibrating or working as approved and screed to provide a level, uniform bearing for precast sections.

D. Manhole cannot be poured over existing pipe and then top of pipe removed to expose sanitary sewer. Pipe shall be cut outside of manhole with a flexible joint installed either side of manhole as shown in the appropriate Standard Drawing.

E. Place the first precast section of manhole in concrete base before concrete has set and deposit sufficient mortar on the base to assure a watertight seal between the base and the manhole wall. First section shall be properly located and plumb. Stacking additional precast manhole sections shall be prohibited until the concrete has cured a sufficient amount to support the additional weight in moist conditions.

F. Prevent broken material or debris from entering sewer flow. Maintain flow through approved sewer lines at all times. Protect new concrete and mortar for a period of seven days after placing. All sanitary sewer manholes shall be hydrostatically tested in accordance with ***Subsection 302.03.07, Vacuum Testing***.

303.03.03 Connection to Existing Main

A. All tests and inspections for watertightness and proper construction shall be completed to the satisfaction of the City Engineer and be performed in accordance with the state plumbing code prior to connection to an existing sewer. Previous use of the service line or building sewer for septic tank or other application, or absence of usable cleanouts for accessing the building sewer, shall not excuse the requirement for testing except as may be authorized by the state building codes inspector.

B. Connections of service lines to existing sewers shall be made watertight. Connection shall be made where possible to existing tees or wyes previously installed. If the tee or wye is plugged, the plug shall be removed and connection made in accordance with the applicable portions of **Section 303, WORK ON EXISTING SANITARY SEWERS**. Transition couplings between dissimilar pipe materials shall be made using HARD fittings. When specifically approved by the City Engineer, flexible connections with stainless steel bands such as Fernco, Caulder, or equal may be used.

C. Where tees or wyes for connection are absent or unusable, connection of service lines shall be typically made with an Inserta Tee® or approved equal. Taps shall be located a minimum of 12 in. from existing pipe joints and other taps. Connection point shall be core drilled in the upper quadrant of the pipe at a 45 degree angle, hole diameter cut to manufacturer's specifications, and hub adapter (manufactured in accordance with ASTM D 3034) shall be connected to rubber sleeve with #316 stainless steel band (9/16 in. wide).

Elastomeric seals shall meet ASTM F 477. Connection shall have a gasketed bell. Incorrect drilled hole size, damage to the City main, or non-tight fitting sewer taps will require resolution as approved by the City Engineer and may require removal and replacement of a section of the main. Other tapping materials must receive prior approval from the City Engineer.

D. All taps shall be inspected and approved by an authorized representative of the local jurisdictional authority.

E. Taps shall be installed without protrusion into or damage to the existing sewer. No compromise of the sewer will be allowed, such as undermining and settlement of the sewer grade, debris in the sewer, or longitudinal or transverse cracking of the sewer pipe.

303.03.04 Removal of Existing Pipes, Manholes and Appurtenances

Existing pipelines, manholes and appurtenances which lie in the line of and are to be replaced by the new construction shall be removed from the site and disposed of as provided for in **Section 203, CLEARING AND GRUBBING**.

303.03.05 Filling Abandoned Manholes, Inlets and Catch Basins

Existing manholes shown to be abandoned shall be filled with granular material as specified in **Section 204, EXCAVATION, EMBANKMENT, BEDDING, AND BACKFILL**. Compact to at least 90% maximum density as determined by ASTM D 1557. Remove manhole frame and cover and plug all pipes with permanent plugs as specified in ***Subsection 303.03.07, Permanent Plugs***. Break or perforate the bottom to prevent the entrapment of water.

303.03.06 Existing Manhole Frames and Covers

Manhole frames and covers removed by the Contractor which will not be reused on the project shall become the property of the City. Notify the City Engineer a minimum of one day prior to removal to arrange for picking up the removed frames and covers.

303.03.07 Permanent Plugs

Clean interior contact surfaces of all pipes to be cut off or abandoned. Construct concrete plug in end of all pipe 18 in. or less in diameter. Minimum length of concrete plugs shall be 8 in. For pipe 21 in. and larger, the plugs may be constructed of common brick or concrete block. Plaster the exposed face of block or brick plugs with mortar. All plugs shall be watertight and capable of withstanding all internal and external pressures without leakage.

303.03.08 Adjusting Existing Structures to Grade

Existing manholes, inlets, catch basins and similar structures shall be brought to the specified finished grade by methods of construction as required in **Section 511, ADJUSTMENT OF EXISTING STRUCTURES TO GRADE**.

303.03.09 Reconstruct Manhole Base

Conform to applicable requirements of **Section 302, MANHOLES AND CONCRETE STRUCTURES**. Exercise caution in chipping out existing concrete base so as to prevent cracking of manhole walls. Prevent all material from entering the sewer flow. Pour new base to a minimum of 6 in. below the lowest projection of the pipe. Construct new channels to the elevations shown. Conform to details for channel construction in the Standard Drawings. Repair any cracks which occur as a result of work operations with new grout to form a watertight seal.

303.03.10 Connect Pipe to Existing Inlets

Conform to applicable requirements of **Section 302, MANHOLES AND CONCRETE STRUCTURES**. Core drill opening in inlet with a concrete saw and grout in a watertight seal between the new pipe and inlet wall. PVC

connection requires boot. Concrete or ductile iron connection requires shear joint located no more than 18 in. from outside of manhole. See standard drawings. Plaster mortar smooth inside pipe opening. Alignment, slope of pipe, and other construction details shall be as specified.

303.03.11 Connection to Existing Manholes

All sanitary sewer pipe connections, including those at invert level and penetrations for drop connectors, conduits, and pass-throughs, shall conform to the requirements of applicable portions of **Section 301, PIPE AND FITTINGS** and **Section 302, MANHOLES AND CONCRETE STRUCTURES**.