

City of West Linn

Public Works Standard Construction Specifications

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DIVISION SIX – STORM DRAIN TECHNICAL REQUIREMENTS

601 PIPE AND FITTINGS

601.01 DESCRIPTION

This section covers the work listed below.

1. Gravity and storm sewer pipe
2. Culverts
3. Perforated pipe underdrains
4. Fittings

601.02 MATERIALS

601.02.01 General

- A. Use all storm 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 3-1/2 ft.
- C. It is not intended that materials listed herein are to be considered equal or generally interchangeable for all applications. The Design Engineer shall determine the materials suitable for the project and so specify on the plans. Contractor must follow materials as specified on the plan as approved by the City.
- D. Green, ribbed PVC pipe conforming to ASTM F 794, is the preferred pipe for storm drains of 24 in. or less in diameter and should be specified for most applications.
- E. Use pipe and fittings of one type of material throughout; no interchanging of pipe and fittings will be allowed. All pipes shall be rubber gasketed.
- F. Do not coat pipes for storm sewers internally or externally with any substance of any type in an attempt to improve its performance when air tested.

601.01.02 Concrete Pipe

601.02.02.01 Nonreinforced Concrete Pipe

Nonreinforced 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.

601.02.02.02 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.

601.02.02.03 Perforated Concrete Pipe

Perforated concrete pipe and fittings shall conform to ASTM C 444 and applicable requirements of ASTM C 14 and C 76 as modified herein, class and end type as specified.

601.02.03 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.

601.02.04 PVC Non-Pressure Pipe and Perforated PVC Pipe

601.02.04.01 Solid Wall

PVC sewer pipe shall conform to ASTM D 3034 SDR-35 or F 794.

601.02.04.02 Perforated Wall

Perforated PVC pipe shall conform to ASTM D 1785, Schedule 40. The perforations shall consist of two rows of 2 in. slots. The slots shall be transverse to the axis of the pipe. Two rows of slots shall be 120° on centers. Slot size shall be 0.4 in.

601.02.05 High Density Polyethylene Pipe (HDPE)

Smooth interior, corrugated exterior HDPE sewer pipe and associated HDPE fittings shall conform to AASHTO M-294, AASHTO 252, ASTM 405 or ASTM 667.

601.02.06 Corrugated Aluminum Alloy Pipe

- A. Corrugated aluminum alloy pipe shall be used only for specialized applications as approved by the City Engineer. Other materials must be demonstrated to be impractical or unavailable.
- B. Corrugated aluminum alloy pipe and coupling bands of the gauges and types as shown or specified shall conform to the material, fabrication, and inspection requirements of AASHTO M-196, Type I or Type II, and AASHTO M-197. Recorrugate the ends of Helical corrugated pipe to receive annular bands at each joint.

601.02.07 Flared End Sections

- A. Precast concrete flared-end sections shall conform to the requirements for Reinforced Concrete Pipe herein specified. The area of steel reinforcement per linear foot of flared-end section shall be at least equal to the minimum steel requirements for circular reinforcement in circular pipe for the internal diameter of the circular portion of the flared-end section. Submit all details of construction to the City Engineer.
- B. Use prefabricated aluminum flared-end sections conforming to AASHTO M-197.

601.02.08 Bituminous Coating

When specified, completely coat the inside and outside surfaces of corrugated pipe with bituminous material conforming to AASHTO M-190 Type A, with a minimum thickness of 0.05 in. at the crest of the corrugations.

601.02.09 Paved Inverts

When specified, bituminously coat the bottom one-half and pave the inside surface of the corrugated metal pipe for 1/4 of its circumference with bituminous material conforming to AASHTO M-190 Type B to provide a flat invert centered in the bottom of the pipe. The pavement, except where the upper edges intersect the corrugations, shall have a minimum thickness of 1/8 in. above the crests of the corrugations. Suitably mark the outside of the pipe on both ends to clearly designate the centerline of the top of the pipe.

601.02.10 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.

601.02.10.01 Concrete Pipe

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. Mortar for tongue and groove pipe shall conform to **Section 205, TYPES AND USE OF MATERIALS.**

601.02.10.02 Cast Iron and Ductile Iron Pipe

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

601.02.10.03 PVC Pipe

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

601.02.10.04 HDPE Pipe

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

601.02.11 Proof Tests

601.02.11.01 General

The intent of this requirement is to pre-qualify 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 storm drains, which are to be tested for water tightness prior to acceptance. 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 suitably 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.

601.02.11.02 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. The 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.

601.02.11.03 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	----

601.02.11.04 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.

601.02.11.05 HDPE Pipe

HDPE pipe shall be tested and meet the requirements of ASTM D 3350 for polyethylene pipe.

601.02.12 Fittings

601.02.12.01 PVC Pipe

In connecting PVC pipe to manholes, use resilient connectors in conformance with ASTM C923.

601.02.13 Couplings, Bands and Fittings for Corrugated Metal Pipe

Use couplings, bands and fittings conforming to AASHTO M-196.

601.03 CONSTRUCTION

601.03.01 Excavation and Backfill

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

601.03.02 Line and Grade for Gravity Storm 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 50 ft.

601.03.03 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 City 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.

601.03.04 Pipe Laying and Jointing of Pipe and Fittings

601.03.04.01 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. 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. For curved sewers the normal gap will be the gap existing when the pipe joints are in the "home" position as described above, for the pipe in the specified deflected position. After installation, prevent movement from any cause including uplift or floating.
- B. Take special care to prevent movement of the pipe after installation when laid within a movable trench shield.
 - C. 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.
 - D. Plug or close off pipes which are stubbed out for manhole construction or for connection by others.
 - E. 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.
 - F. When cutting and/or machining the pipe is necessary, use only tools and methods recommended by pipe manufacturer.
 - G. 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.

601.03.04.02 Concrete Pipe

Use rubber ring gasket joints unless mortar joints are specifically specified. When mortared joints are used, the entire joint for the full circumference of the pipe shall be completely filled with mortar. The surfaces of the pipe joint shall be brushed clean prior to mortaring. Fill the exterior of the joint with mortar and in the case of bell and spigot joints, fill to an angle of 45°.

601.03.04.03 Corrugated Metal Pipe

Repair all damaged areas of the protective coating with material equal to the original and permit to dry or solidify before backfilling.

601.03.05 Perforated Pipe Underdrains

601.03.05.01 Trench Excavation and Backfill

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

601.03.05.02 Pipe Bedding

Provide a minimum 4 in. bedding of 1-1/2"-3/4 rock under perforated drain pipe, or as shown. Hand grade the bedding to proper grade ahead of pipe laying. Provide a firm, unyielding support along the entire pipe length. 3/4"-0

601.03.05.03 Backfill at the Pipe Zone

Backfill the pipe zone with 1-1/2"-3/4 rock hand placed simultaneously on both sides of the pipe for the full trench width.

601.03.05.04 Backfill Above the Pipe Zone

Use 1-1/2"-3/4 rock for backfill above the pipe zone, unless otherwise specified.

601.03.05.05 Laying and Jointing Perforated Pipe

- A. Securely fasten together perforated pipe with couplings, fittings, or bands as specified by the manufacturer for the type of the pipe used. Close upgrade ends of all subsurface drain pipe with approved plugs to prevent entry of soil materials.
- B. Begin pipe laying normally at the outlet end of the pipe line. The lower segment of pipe shall be in contact with the shaped bedding throughout its full length. Bell or groove ends of rigid pipe and outside circumferential laps of flexible pipe shall be placed facing the upgrade end.
- C. Lay all perforated pipe, except perforated PVC pipe, with perforations facing down, unless otherwise specified or directed. Place perforated PVC Drain Pipe with slots facing up.
- D. Inspect all pipe prior to lowering into the trench and, if necessary, clean off any material tending to plug the perforations of the pipe. Carefully lower all pipe and fittings into the trench to avoid any contamination of the filter bedding material.

601.03.06 Flared End Sections

Construct flared end sections in accordance with the details and dimensions shown, except that minor variations may be accepted to permit the use of the manufacturer's standard prefabricated sections and methods of fabrication. Conform excavation, bedding and backfill to applicable requirements herein for the adjacent pipe or drain to be joined.

601.03.07 Pipe Coupling Adapters

Use of hard fitting is required when transitioning between dissimilar pipe materials, unless no such fitting is available (simply because part is not in stock or is a special order is not justifiable cause for use of a flexible fitting). When approved by the City Engineer or his/her representative, use flexible mechanical compression joint coupling with No. 305 stainless steel bands manufactured by Joints, Inc., Fernco Joint Sealer or equal.

601.03.08 Concrete Closure Collars

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. Wet nonmetallic pipe thoroughly prior to placing the collars. 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. After the collars are placed and have taken their initial set, cure by covering with well-moistened earth. Do not backfill the trench until the concrete has sufficient strength.

601.03.09 Culverts

Remove and replace culverts in conformance to all applicable requirements of this section and **Section 204, EXCAVATION, EMBANKMENT, BEDDING, AND BACKFILL.**

601.03.10 Testing Storm Drains

601.03.10.01 General

- A. The Contractor shall make a televised inspection of the storm drain pipe. Use pan & tilt camera types only. Every lateral shall be inspected and identified on tape. Any defects in material or workmanship shall be satisfactorily corrected prior to final acceptance of the work.
- B. When the quality of materials used or workmanship performed during the construction of storm drains is in doubt for any reason, the City Engineer may require the storm drain and all applicable appurtenances to be tested. When so ordered, the storm drain shall be required to pass the same air test as specified for sanitary sewers in **Subsection 301.03.10, Deflection Test for PVC Pipe.**

- C. All tests and inspections (including video-inspection) must be performed in the presence of the City Engineer or his/her representative to be valid.
- D. Tests shall be performed in the following order: deflection testing, air pressure testing (if required per 601.03.10A.2), 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.
- E. Deflection testing, air pressure testing (if required), 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, proofrolled, and approved by the City Engineer.
- F. The storm system must receive the City Engineer's approval regarding deflection testing, air pressure testing (if required), and video inspection before paving of overlying roadways will be permitted.

601.03.10.02 Cleaning Prior to Testing and Acceptance

- A. Prior to final testing, acceptance and final manhole-to-manhole inspection of the storm 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 storm sewer system at or near the closest downstream manhole. If necessary, use mechanical rodding or bucketing equipment.
- B. Upon the City Engineer's final manhole-to-manhole inspection of the storm sewer system, if any foreign matter is still present in the system, reflush and clean the sections and portions of the liens as required.

601.03.10C Repairs

- A. Repair or replace, in a manner satisfactory to the City Engineer, any section of pipe not meeting the test requirements, or which has leakage.
- B. Infiltration of ground water following a successful air test as specified, shall be considered as evidence that the original test was in error or that subsequent failure of the pipeline has occurred. Correct such failures occurring within the warranty period in a manner satisfactory to the City Engineer at the Contractor's sole expense.

601.03.11 Deflection Test for PVC, Ribbed PVC, and HDPE Pipe

- A. Perform a deflection test for all storm drains and culverts constructed of PVC, Ribbed PVC, and HDPE 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 after compaction is completed.
- B. The diameter of the mandrel shall be 95% of the internal pipe diameter. 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.

601.03.12 Television Inspection of Storm Drains

- A. Upon completion of all storm drain construction, repairs, cleaning, and required tests, notify the City Engineer that all lines are ready for televising inspection.
- B. Subsequent to being notified, the City Engineer shall commence examination of lines or may waive the television inspection. Findings will be recorded. Correct all deficiencies at the Contractor's sole expense.
- C. Upon correction of deficiencies revealed by televising, notify the City Engineer; the same steps listed above may be repeated until all work is acceptable.
- D. The Contractor may, at its own option, perform a deflection test at the same time it performs its television inspection.

- E. 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.
- F. When performing television inspections, water shall be added, tracing dye and a 1 in. measuring ball shall be utilized. Use pan-and-tilt camera types only and every lateral shall be inspected and identified on tape.

601.03.13 Subsequent Failure

No infiltration of ground water in the system is allowed. No standing water greater than 3/8 in. is allowed.

602 MANHOLES, INLETS AND CONCRETE STRUCTURES

602.01 DESCRIPTION

This section covers the work necessary for the construction of items listed below.

- 1. Manholes
- 5. Sumps
- 6. Inlets and Catch Basins
- 7. Anchor Walls
- 8. Special Concrete Structures
- 9. Concrete Encasement

602.02 MATERIALS

602.02.01 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.**

602.02.02 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.

602.02.03 Concrete and Reinforced Steel

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

602.02.04 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.

602.02.05 Manholes

602.02.05.01 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 loadings shall be provided for manholes 6 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 14 and ASTM C 497.

602.02.05.02 Precast 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.

602.02.05.03 Poured in Place Manhole Bases

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

602.02.05.04 Manhole Grade Rings

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

602.02.05.05 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.

602.02.06 Pipe and Fittings

Conform to requirements of **Section 601, PIPE AND FITTINGS.**

602.02.07 Precast Inlets and Catch Basins

Precast base and extension units shall conform to ASTM C 913 and shall be used in the construction of all inlets and catch basins. Concrete risers for extensions shall be a minimum of 4 in. in height and shall be the same quality as the main section.

602.02.08 Manhole and Cleanout Frames and Covers

602.02.08.01 General

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. 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. 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 and set to an elevation 1 ft. above finish grade.

602.02.08.01 Materials

Conform to ASTM A 48, Class 30B, with the revisions indicated in the table below.

Tensile Strength	30,000 psi
Traverse Strength (1.2 in. dia. bar - 18 in. centers) Load - Pounds	1,600 - 3,000
Deflection - Inches	0.22 - 0.34
Brinell Hardness (as cast)	173 – 200

The Foundry shall certify as to the tensile and traverse properties and the Brinell Hardness. The Owner reserves the right to require a Rough Traverse bar (size of bar 1.2 in. dia. 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.

602.02.08.03 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.

602.02.09 Standard Frames and Grates for Inlets and Catch Basins

Frames and grates for catch basins and storm drain inlets shall be fabricated of steel conforming to ASTM A 7, A 36, A 373 in accordance with the details shown on the Standard Drawings. All connections shall be welded. Welding shall conform to requirements of current code for welding in building construction of the American Welding Society. Frames and gratings shall be tested one within the other, and there shall be no more than 1/16 in. rock. When checked by a test jig, the bearing seat of either component shall have no more than 1/16 in. rock. Test jibs shall be furnished by the manufacturer.

602.02.10 Steps for Precast Manholes

Manhole steps will comply with **Section 302, MANHOLES AND CONCRETE STRUCTURES**.

602.02.11 Storm Sumps

The precast sections will comply with **Subsection 602.02.05, Manholes**. The frame and cover will comply with **Subsection 602.02.08, Manhole and Cleanout Frames and Covers** and will be tamper-proof when the sump is located outside the right-of-way. The steps will comply with **Subsection 602.02.10, Steps for Precast Manholes**. Drain rock will be clean round imported material and the size will be 2" to 4". The filter fabric will be Mirafi 140 or equal.

602.03 CONSTRUCTION

602.03.01 General

602.03.01.10 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.

602.03.01.02 Base Rock

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

602.03.01.03 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**.

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

602.03.03 Pipe Stubouts from Manholes

Install stubouts from manholes at locations as shown or directed using sand collar or rubber boot. Grout or install pipes into manhole walls or manhole base so as to provide watertight seal around pipes. Provide manhole with resilient connector for PVC pipe. Pipe connection shall be by core drilling only. Pipe connections to the cone section of a manhole are strictly prohibited.

602.03.04 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. Seal joints with mortar to provide a watertight seal. Grade ring extensions shall be watertight.

602.03.05 Adjustment of Manholes to Grade

- A. Frame and cover shall be brought 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 a standard cast iron riser shall be used to adjust grade at a later date for final lift. (Resolution 05-10 4/11/05)
- B. All storm manhole located outside of paved areas shall be raised 12 in. above final grade and tamper proofed frames and lids shall be used. (Resolution 05-10 4/11/05)

602.03.06 Vacuum Testing

Manholes may be vacuum tested at the discretion of the City Engineer according to guidelines listed in **Subsection 302.03.07, Vacuum Testing.**

602.03.07 Concrete Encasement for Storm Drainage Pipe

- 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 the 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 Drawing.
- 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.

602.03.08 Special Concrete Structures

Conform to the details as shown.

602.03.09 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.

602.03.10 Installation of Inlets and Catch Basins

- A. Install inlets and catch basins at the locations shown on the Plans or where directed by the Design Engineer.
- B. Construct inlets and catch basins as shown on the Standard Drawings. All inlets and catch basins constructed with precast units shall conform to ASTM C 913. The top section, including curb, gutter, and frame, shall be cast-in-place. The Contractor may use poured in place inlets and catch basins in accordance with the Standard Drawings. Concrete shall conform to **Section 205, TYPES AND USE OF MATERIALS**.
- C. Set frames and grates at elevations shown or as directed. Frames shall be cast in concrete. Bearing surfaces shall be clean and provide uniform contact. Anchor bolts and other fastenings shall be firmly embedded in concrete.
- D. Any surrounding structures (e.g., pavement, curbs, gutters, sidewalks, driveways) and landscaping damaged during installation of inlets or catch basins shall be restored in accordance with these Standard Specifications at the Contractor's sole expense.

602.03.11 Inlet and Catch Basin Extensions

Install extensions to height as required. Use the largest size (in height) pre-cast extension risers available from the manufacturer that will allow for conformance with the specified finished grade. Stacking small pre-cast extensions where a larger extension could be used is prohibited. Lay risers in mortar with sides plumb and tops to grade. Joints shall be sealed with mortar, with interior and exterior troweled smooth. Prevent mortar from drying out and cure by applying an approved curing compound or other approved method. Extensions shall be watertight.

602.03.12 Cleaning

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

602.03.13 Steps for Precast Manholes

Steps shall comply with that specified in **DIVISION THREE – SANITARY SEWER TECHNICAL REQUIREMENTS**.

602.03.14 Drywells

Drywells are not allowed in the City of West Linn.

603 WORK ON EXISTING STORM DRAINS DRAINAGE STRUCTURES

603.01 DESCRIPTION

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

603.02 MATERIALS

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

603.03 CONSTRUCTION

603.03.01 Excavation and Backfill

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

603.03.02 Manholes Over Existing Storm Sewers

- A. Advise City Engineer of system for diverting 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 storm sewers 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 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 storm drain. 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 storm sewer. Maintain flow through approved lines at all times. Protect new concrete and mortar for a period of seven days after placing.

603.03.03 Connection to Existing Manholes, Inlets and Concrete Structures

Provide all diversion facilities and perform all work necessary to maintain flow in existing lines during connection. Manhole connections shall be done by core drilling only. Grout in new pipe to provide watertight seal, and when applicable, smooth flow into and through existing manhole as specified in **Subsection 603.03.09, Reconstruct Manhole Base**.

603.03.04 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**.

603.03.05 Filling Abandoned Manholes, Inlets and Catch Basins

Existing manholes, inlets, and catch basins 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. For catch basins, remove frame and grate. For manholes, remove frame and cover and top cone section (or flat top). Plug all pipes with permanent plugs. Final grade shall be specified by the Design Engineer. Break or perforate the bottom to prevent the entrapment of water.

603.03.06 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 at the City's discretion.

603.03.07 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.

603.03.08 Adjust 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**.

603.03.09 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 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.

603.03.10 Connect Pipe to Existing Inlets

Conform to applicable requirements of **Section 302, MANHOLES AND CONCRETE STRUCTURES**. Core drill opening and grout in a watertight seal between the new pipe and inlet wall. Plaster mortar smooth inside pipe opening. Alignment, slope of pipe, and other construction details shall be as specified.

603.03.11 Storm Sump Protection

When a storm sump is encountered the Contractor will take all precautions to protect the structure, and replace all disturbed structures and materials to their original condition.

603.03.12 Storm Laterals

- 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 storm sewer. Previous use of the service line for other applications, or absence of usable cleanouts for accessing the building storm 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 storm sewers shall be made watertight. Connection shall be made where possible to existing tees or wyes previously installed and plugged. Transition couplings between dissimilar pipe materials shall be made using hard fittings. Flexible connectors with stainless steel bands

such as Fernco, Caulder, or equal may be used only when specifically approved by the City Engineer and will only be considered on a case by case basis.

- C. Where tees or wyes for connection are absent or unusable, connection of service lines shall be typically made with an Inserta Tee® or City 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 storm 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 storm sewer. No compromise of the storm sewer will be allowed, such as undermining and settlement of the storm sewer grade, debris in the storm sewer, or longitudinal or transverse cracking of the storm sewer pipe.

604 DETENTION/RETENTION POND REQUIREMENTS

604.01 CONSTRUCTION REQUIREMENTS

- A. All pond outlet structures shall be designed with anti-seepage collars per Standard Drawing WL-205B detail.
- B. Soil groups A or B require installation of a liner. In soil groups C and D, liner may be required at the discretion of the City Engineer in specific cases and conditions.
- C. A pollution control manhole is required preceding the inlet to the pond structure. (Resolution 05-10 4/11/05)
- D. Ponds active in wet weather season without established side slope and/or bottom vegetation shall have river rock lining the bottom and up the sides to the water quality level or 24 in. from bottom, whichever is greater. (Resolution 05-10 4/11/05)

604.02 POND TESTING REQUIREMENTS

- A. All ponds shall pass a hydrostatic test prior to City acceptance/approval. During the pond testing process the perimeter of the pond area shall have temporary fencing. The test shall be conducted according to the following guidelines:
 - 1. Plug outlet structure(s) and fill the pond to the 25-year detention depth.
 - 2. Record the volume of water required to meet the 25-year detention depth.
 - 3. The test shall last for a period of not less than 24 hrs. once the City has authorized the testing time to begin. (i.e. there may be an initial saturation period required)
 - 4. At the end of the testing period the loss of water is recorded.
 - 5. The loss shall not exceed 40% in a 24-hour period except in below grade facilities
 - 6. There shall be no visible signs of failure such as seepage, cracks, blow-outs, or erosion.
- B. In the instance, if a storm event occurs during a hydrostatic test, the City reserves the right to terminate the test and re-test under conditions necessary to insure an accurate assessment.
- C. All costs associated with the testing of the detention/retention facility shall be incurred by the developer. (Resolution 05-10 4/11/05)

604.03 UNDERGROUND DETENTION TANK TESTING REQUIREMENTS

- A. All underground detention tanks shall pass a hydrostatic test prior to City acceptance/approval. The test shall be conducted according to the following guidelines:
 - 1. Plug outlet structure(s) and fill the facility to the top of the manhole access port.
 - 2. Record the volume of water required to attain the manhole access port.
 - 3. No water shall be added to the tank and the manhole access ports shall remain locked during the test period.
 - 4. The test shall last for a period of two hours once the City has authorized the testing time to begin.
 - 5. Zero loss is allowed in order to pass.