

**SECTION 3500 - SANITARY SEWERS**  
**CITY OF LEE'S SUMMIT, MISSOURI**  
**STANDARD SPECIFICATIONS**

**3501 MATERIALS**

- A. General: All materials shall conform to the latest revision of the reference standard applying to that particular material.
- B. Pipe and Fittings for Sanitary Sewers
1. Allowable Materials: Pipe and fitting materials used in the construction of sanitary sewers shall be:
    - a. Ductile Iron (DI) special thickness Class 50
    - b. Polyvinyl Chloride (PVC)
    - c. High Density Polyethylene (HDPE) (for force mains only)
  2. Requirements: The pipe manufacturer shall furnish pipe of materials, joint types, sizes, and strength classes indicated and specified. The Contractor shall furnish maximum pipe lengths normally produced by the manufacturer except for fittings, closures, and appurtenances.
  3. Manufacturer's Experience: The Manufacturer shall be experienced in the design, manufacture, and commercial supplying of the specified material.
  4. Inspection and Testing: Inspection and testing shall be performed by the Manufacturer's quality control personnel in conformance with applicable standards.
  5. Markings: Each pipe or fitting shall have the following information plainly and permanently marked by indenting in the outside surface of the pipe or painted thereon with waterproof paint:
    - a. Pipe size and class or designation.
    - b. Date manufactured and lot number.
    - c. Manufacturer's name or trademark.
    - d. For ductile iron pipe, in lieu of the above listed markings, the information may be provided on an adhesive bar code labeling system that complies with AWWA Standards. The adhesive label shall be provided on the outside surface near the bell.
  6. Handling: The Manufacturer and Contractor/Developer shall use equipment and methods adequate to protect the pipe and joint elements and to prevent shock contact of adjacent units during moving or storage. Damaged sections that cause reasonable doubt as to their structural strength or water-tightness shall be rejected.
  7. On-Site Inspection: All pipe and appurtenances shall be inspected by the Inspector prior to installation, and all damaged pieces, as well as any pieces not complying with

the City of Lee's Summit Standard Specifications, shall be immediately removed and replaced by pipe and appurtenances as may be acceptable to the Inspector at the expense of the Contractor/Developer.

8. Certification: Suppliers shall submit certifications with their material delivery. These certifications shall be given to the Inspector.

C. PVC Sewer Pipe and Fittings

1. Type PSM PVC Sewer Pipe and Fittings (4-inch through 15-inch diameters only): Pipe and fittings shall conform to ASTM D 3034 and F1336, except as otherwise specified herein.
  - a. Material: The pipe shall be made of PVC plastic having a cell classification of 12454B or 12364B as defined in ASTM D 1784. The fittings shall be made of PVC plastic having a cell classification of 12454B or 13343B as defined in ASTM D1784.
  - b. Design: Pipe shall have an integral wall bell and spigot joint and a minimum wall thickness complying with SDR 26. Fittings shall have a minimum wall thickness complying with SDR 26.
  - c. Joints: Joints shall conform to ASTM D 3212. Joints shall be push-on type only with the bell-end grooved to receive a gasket. Elastomeric seals (gasket) shall have a basic polymer of synthetic rubber complying with ASTM F 477. Natural rubber gaskets shall not be accepted.
  - d. Fittings:
    - i. Fittings defined as wye connections suitable for assembly to 4- or 6-inch building sewers shall be bell-end with a minimum wall thickness complying with SDR 26 and shall be furnished by the pipe manufacturer.
    - ii. Fittings shall be clearly marked with their SDR number. The markings shall be applied to the fittings in such a manner that they remain legible after installation and inspection has been completed.
2. PVC Pressure-Rated Pipe (SDR Series): Pipe shall conform to ASTM D 2241 except as otherwise specified herein.
  - a. Material: The pipe shall be made of PVC plastic having a cell class of 12454B or 14333B, as defined in ASTM D 1784.
  - b. Design: Pipe shall have an integral wall bell and spigot joint. Pipe shall have a minimum wall thickness complying with Table 2 in ASTM D 2241.
  - c. Joints: Joints shall conform to ASTM D 3212 for gravity lines and ASTM D 3139 for pressure lines. Joints shall be push-on type only with the bell-end grooved to

receive a gasket. Elastomeric seals (gasket) shall have a basic polymer of synthetic rubber complying with ASTM F 477. Natural rubber gaskets shall not be accepted.

- d. Fittings: Fittings shall be DI and shall conform to the requirements of Paragraph 3501.D.
3. PVC Plastic Pipe, Schedule 40: Pipe and fittings shall conform to ASTM D 1785 and ASTM D 2466, respectively, except as otherwise specified herein.
    - a. Material: The pipe and fittings shall be made of PVC plastic having a cell class of 12454B, as defined in ASTM D 1784.
    - b. Design: Pipe shall have an integral wall bell and spigot joint. Pipe shall have a minimum wall thickness complying with Table 2 in ASTM D 1785. Fittings shall have a minimum wall thickness complying with Table 1 in ASTM D 2466.
    - c. Joints: Joints shall conform to ASTM D 3212. Joints shall be push-on type only with the bell-end grooved to receive a gasket. Elastomeric seals (gasket) shall have a basic polymer of synthetic rubber complying with ASTM F 477. Natural rubber gaskets shall not be accepted.
    - d. Fittings:
      - i. Fittings shall be bell-end with a minimum wall thickness complying with Schedule 40 and shall be furnished by the pipe manufacturer.
      - ii. Fittings shall be clearly marked with their schedule number. The markings shall be applied to the fittings in such a manner that they remain legible after installation and inspection has been completed.
  - D. Ductile Iron Pipe (DIP) and Fittings: Pipe and fittings shall conform to ANSI/AWWA C151/A21.51, ANSI/AWWA C110/A21.10, and ANSI/AWWA C153/A21.53 except as otherwise specified herein.
    1. Design: All DIP shall meet the requirements of ANSI/AWWA C150/A21.50 and ANSI/AWWA C151/A21.51. The minimum thickness shall be Special Thickness Class 50.
    2. Joints: Mechanical and push-on joints for pipe and fittings shall conform to the requirements of ANSI/AWWA C111/A21.11. Natural rubber gaskets shall not be accepted.
    3. Coatings: Pipe and fittings shall be furnished with exterior bituminous coating complying with ANSI/AWWA C151/A21.51.
    4. Linings: Pipe and fittings shall have a hydrogen sulfide resistant ceramic quartz filled amine cured novalac epoxy interior lining, 40 mil nominal thickness. Refer to the Water Utilities List of Acceptable Manufacturers and Models.

5. Polyethylene Encasement: All ductile iron pipe and fittings shall be installed with a polyethylene tube encasement having a thickness of 0.008 inches (8 mils) and complying with Section 4.1.1. of ANSI/AWWA C105/A21.5.
- E. HDPE Pipe and Fittings: Pipe and fittings shall conform to ANSI/AWWA C901 and ANSI/AWWA C906 except as otherwise specified herein.
    1. Material: The pipe and fittings shall be made of polyethylene (PE) plastic having a grade of PE34 with a minimum cell classification of 345464C, as defined in ASTM D 3350.
    2. Design: All HDPE pipe and fittings shall meet the requirements of ANSI/AWWA C901 and ANSI/AWWA C906. Pipe shall have a minimum wall thickness complying with DR 11. The pressure class shall be 1.5 times the working pressure plus 100 psi surge allowance.
    3. Fittings: HDPE fittings shall comply with ANSI/AWWA C906 and the requirements of ASTM D 2683 for socket-type fittings, ASTM D 3261 for butt heat fusion fittings, and ASTM F 1055 for electrofusion type fittings.
  - F. Concrete: Concrete shall be a MCIB mix with a design strength of 4500 psi, unless otherwise shown on plans. Mix shall meet MCIB Specifications November 2007 as listed on the Concrete Promotional Group Website [www.concretepromotion.com](http://www.concretepromotion.com).
  - G. Granular Bedding Aggregate Material: See Section 2100.
  - H. Backfill: See Section 2100.
  - I. Flowable Backfill: Flowable backfill shall consist of Controlled Low Strength Material (CLSM) complying with the requirements of Section 2100, Mix Design Type A.
  - J. Trench Checks: Trench checks shall consist of flowable backfill as specified in Paragraph 3501.I.
  - K. Pipe Encasement: Concrete used for pipe encasement shall be a 4500 psi MCIB mix. Reinforcing steel shall be new billet steel complying with the requirements of ASTM A 615, Grade 60.
  - L. Pipe Collars: Concrete, whether reinforced or non-reinforced, used for pipe collars shall be a 4500 psi MCIB mix. Reinforcing steel, when required, shall be new billet steel complying with the requirements of ASTM A 615, Grade 60.
  - M. Pipe Anchors: Concrete, whether reinforced or non-reinforced, used for pipe anchors shall be a 4500 psi MCIB mix. Reinforcing steel, when required, shall be new billet steel complying with the requirements of ASTM A 615, Grade 60.
  - N. Building Sewer Stubs: Building sewer stubs shall be SDR 26 (minimum) PVC.

O. Casing pipe

1. Pipe

- a. The casing pipe shall be made of steel, meeting the requirements of ASTM A 139, grade B, with a minimum yield strength of 35,000 psi.
- b. The minimum wall thicknesses required are shown in the following table:
- c.

<b>Casing Diameter (inch)</b>	<b>Minimum Wall Thickness</b>
10, 12, 14, 16	0.188" (3/16")
18, 20, 22	0.250" (1/4")
24, 26	0.281" (9/32")
28, 30, 32, 34	0.312" (5/16")
36, 38, 40, 48	0.344" (11/32")

2. Pipe Supports:

- a. **Casing Spacers:** Casing spacer shall be a two-piece shell or band made from T-304 stainless steel of a minimum 14 gauge thickness. The shell/band shall have risers made of 10 gauge T-304 stainless steel and have a PVC liner. The bearing surface (skid or runner) shall be made of an ultra high molecular weight polymer, glass reinforced polyester, or fiberglass reinforced nylon. The shell/band shall be bolted together with T-304 stainless steel bolts. The configuration of the carrier pipe in the casing pipe shall be centered. End seals shall be made by the same manufacturer as the casing spacers and shall use stainless steel bands to hold end seals to pipes.
- b. **Wood Skids:**
  - i. Wood skids shall be made of 4-inch by 4-inch pressure treated lumber, 3 feet long.
  - ii. Skids shall be attached to sewer pipe with two stainless steel bands.
  - iii. When woods skids are used, sand shall be blown into the annular space between the sewer and casing pipes.
  - iv. Skids shall be spaced at 120° intervals around the circumference of the pipe. Two skids shall be used on each end of the pipe joint.
- 3. **Ends of the Casing Pipe:** The ends of the casing pipe shall be closed with one of the following (see the Standard Drawings):
  - a. Manufactured end seal.
  - b. Concrete plug with allowances for water flow.

P. Manholes

1. Precast Sections: Precast concrete manholes shall conform to ASTM C 478 with the following modifications.
  - a. Wall thickness not less than one-twelfth of inside diameter, or 4 inches, whichever is greater, shall be used.
  - b. Cement, fine aggregate, coarse aggregate and water used in the manufacture of precast manholes shall be as specified in MCIB, Section No. 1 (Materials).
  - c. Integral cast bases shall be used unless prior approval is obtained from the City Engineer. The diameter of the base pad shall be 8 inches greater than outside diameter of the manhole.
  - d. Pipe penetrations shall be fitted with a flexible pipe-to-manhole connector. Refer to the Water Utilities List of Acceptable Manufacturers and Models.
  - e. The minimum distance from the invert of the downstream pipe to the top surface of the base shall be 3 inches.
  - f. Riser Rings
    - i. Concrete: Precast riser rings shall be 4 inches or 6 inches in thickness. The use of lightweight concrete with fiber reinforcement is recommended. Reinforcing shall conform to ASTM C 478. Tongue and groove joints shall be used.
    - ii. HDPE: Injection-molded HDPE adjusting rings as manufactured by Ladtech, Inc.
2. Cast-In-Place-Concrete: Concrete shall comply the requirements of a 4500 psi MCIB mix.
3. Reinforcing Steel: Reinforcing steel shall be new billet steel complying with the requirements of ASTM A 615, Grade 60.
4. Joint Sealant
  - a. Between Precast Sections: Joints between precast manhole pipe sections and between the manhole casting frame and precast manhole pipe sections shall be sealed with preformed butyl joint sealants meeting the requirements of ASTM C 990. The minimum bead dimension shall be 1 square inch. The butyl component of the preformed joint sealant shall consist of 60 percent (minimum) butyl rubber. Preformed joint sealants shall remain flexible at temperatures as low as 0° F. Refer to the Water Utilities List of Acceptable Manufacturers and Models.

- b. Exterior of Joints: The exterior of all joints including the joint between the manhole casting frame and the precast manhole pipe sections shall be sealed with one of the following:
  - i. Press-Seal EZ-Wrap Butyl joint wrap with rubber backing, 6-inch wide, or an approved equal: The butyl component of the tape shall consist of 50 percent (minimum) butyl rubber, shall contain 2 percent or less volatile matter, and shall be 0.030 inches thick. The backing component shall be EPDM rubber. A release paper may be utilized. Refer to the Water Utilities List of Acceptable Manufacturers and Models.
  - ii. Heat-shrinkable joint wrap complying with ANSI/AWWA C216: The wrap system shall consist of a two-part material (backing + adhesive) with a closure system and a compatible primer. It shall consist of an irradiated and cross-linked polyolefin sheeting, pre-coated with a layer of anti-corrosion adhesive. The backing shall have a minimum recovery of 22%. The adhesive shall be a mastic-type, specially formulated to become fluid at temperatures achieved during installation and maintain flexibility in cold climates with installation temperatures down to -40°F. Upon cooling the adhesive shall form a tough, elastomeric protective layer. The wrap shall employ a closure seal to allow sealing of the overlap area. The overall thickness of an applied sleeve shall nominally measure 0.100 inches (2.5 mm). Refer to the Water Utilities List of Acceptable Manufacturers and Models.
  - iii. The casting shall be sealed to the structure with an external sealing system. The seal shall be a continuous band, made of EPDM (Ethylene Propylene Diene Monomer) rubber with a minimum thickness of 65 mils. Each unit shall have a 2" wide mastic strip on the top and bottom edge rubber band. The mastic shall be non-hardening butyl rubber sealant, with a minimum thickness of 1/4", and shall seal to the cone/top of the manhole and over the lip of the casting. Refer to the Water Utilities List of Acceptable Manufacturers and Models. Prior to placement of the mastic against the manhole or casting, the surfaces shall be coated with a primer capable of enhancing the mastic adhesion. The primer coat shall cover the entire surface area where the mastic is intended to adhere. Refer to the Water Utilities List of Acceptable Manufacturers and Models.
- 5. Non-Shrink Grout: Non-shrink grout shall be in the plastic state and show no expansion after set as tested in accordance with ASTM C 827 and shall develop compressive strength not less than 3,000 pounds per square inch with a trowelable mix within 24 hours per ASTM C 109. The placement time shall be not less than 45 minutes based on initial set per ASTM C 191.
- 6. Gasket: Pipe openings shall contain flexible gaskets complying with the requirements of ASTM C 923. Refer to the Water Utilities List of Acceptable Manufacturers and Models.

7. Waterproofing: All precast sections shall be waterproofed prior to shipment to the project site. Waterproofing shall be accomplished using one of the following coatings:
  - a. When a sewage force main terminates in a manhole, the internal surface of the first two receiving manholes shall be lightly sandblasted and coated with a total dry film thickness of not less than 8.0 mils of Tnemec Series 69 Hi-Build Epoxiline II or approved equal.
  - b. Exterior manhole surfaces shall be coated with one of the following materials:
    - i. A total dry film thickness of not less than 14.0 mils of bituminous coating.
    - ii. A total dry film thickness of not less than 4.0 mils of Tnemec Series 66 Hi-Build Epoxiline or approved equal.
8. Manhole Steps: Steel core plastic coated steps shall meet the following minimum requirements:
  - a. The standard plastic coated step shall be as referenced in the Water Utilities List of Acceptable Manufacturers and Models.
  - b. The plastic coating shall be a copolymer polypropylene complying with ASTM D 4101 with a classification of PP0344B33534Z02 or better.
  - c. The steel core shall be a minimum of ½ inch in diameter and shall conform to ASTM A 615, grade 60.
9. Manhole Castings
  - a. Material for all iron castings shall comply with the requirements of “Drainage Structure Castings,” AASHTO M306, Section 3, except if cast iron is used, it shall be ASTM A48/AASHTO M105, Class 30B or better.
  - b. Workmanship and Finish: Manhole castings shall comply with the requirements of AASHTO M306, Paragraphs 4.1 and 5.1. All castings shall be manufactured true to pattern and component parts shall fit together in a satisfactory manner.
  - c. Seating and Bearing Surfaces: All horizontal-bearing surfaces shall be machined. Castings shall conform to the requirements of AASHTO M306, Paragraph 4.3.
  - d. Rating: Castings shall be heavy duty and capable of handling loads of at least 40,000 pounds. Proof-load testing shall conform to the requirements of AASHTO M306, Section 7. Proof-load testing is not required for the adapters (Lee’s Summit ID Nos. LS106A-D, LS107A-D).

e. Markings:

- i. Imported castings shall meet the country-of-origin markings as required in Title 19, Code of Federal Regulations, Part 134 (19 CFR 134).

Lettering for country-of-origin marking shall not exceed 1 ½ inches.

- ii. Castings shall conform to the requirements of AASHTO M306, Section 11. Julian heat date shall be cast, not stamped, into the castings.

- f. Dimensional Tolerances: The dimensions of all castings shall be within the permissible variations specified in AASHTO M306, Paragraph 4.2, except 4.2.4 shall be replaced with the following: No casting shall weigh less than 95 percent of the specified weight shown on the Standard Drawings.

g. Frames and Covers: Frames and covers shall meet the following minimum requirements:

- i. Critical dimensions and Lee’s Summit part numbers shown in the Standard Drawings.
- ii. All manhole frames (except the slab bolt-down manhole frame) shall be designed and delivered with a full mud ring. Partial projections shall not be accepted.
- iii. All covers shall have two concealed pickholes that meets the manufacturer’s requirements.
- iv. All covers shall have the “City of Lee’s Summit” and “Sewer” cast into the piece in 1 ½-inch and 3-inch letters, respectively.
- v. Castings shall be fully interchangeable in the field with the equivalent Clay & Bailey models indicated in Paragraph 3501.P.9.h.vi.below.
- vi. All parts shall have a Lee’s Summit part number cast into the piece in 1-inch letters. Location of the part number shall be such that when the part is installed, part number shall be readily visible without excavation of adjacent material. Part numbers shall be as shown below:

<b>Part No.</b>	<b>Description</b>
LS101A	Standard 24” Manhole Frame (Clay & Bailey 2007MR) - Matching cover is LS101B
LS101B	Standard 24” Manhole Cover (Clay & Bailey 2007) - Matching frame is LS101A
LS102A	Bolt-down Manhole Frame (Clay & Bailey 2014OR) - Matching cover is LS102B
LS102B	Bolt-down Manhole Frame Cover (Clay & Bailey 2014OR)

	- Matching frame is LS102A
LS103A	Slab Manhole Frame (Clay & Bailey 2002) - Matching cover is LS103B
LS103B	Slab Manhole Cover (Clay & Bailey 2007) - Matching frame is LS103A
LS104A	Slab Bolt-down Manhole Frame (Clay & Bailey KCMO R4) - Matching cover is LS104B
LS104B	Slab Bolt-down Manhole Cover (Clay & Bailey KCMO R4) - Matching frame is LS104A

vii. Covers marked with other cities' names and/or logos shall not be accepted.

viii. Covers located in the street right-of-way or adjacent utility easement shall be hot-dipped asphalt coated.

ix. Refer to the Water Utilities List of Acceptable Manufacturers and Models.

10. Epoxy Manhole Liner: Epoxy manhole liners shall be installed inside the first two receiving manholes downstream of force main sanitary sewer system and shall meet the following minimum requirements:

a. Epoxy Manhole Liner for Manholes: The epoxy manhole liner shall be chemical resistant (below a pH of 2.0), VOC compliant, moisture tolerant, 100% solids, two (2) component epoxy system with the following properties:

Flexural Strength [ASTM D-790]: >10,000 psi

Compressive Strength [ASTM D-695]: >10,000 psi

Tensile Strength [ASTM D-638]: >7,000 psi

Adhesion: Concrete Substrate Failure

b. Refer to the Water Utilities List of Acceptable Manufacturers and Models.

Q. Utility Markers:

1. Utility marker tape shall be minimum 2 inches wide, 4-mil thick green plastic tape with the word "SEWER" lettered in permanent black graphics.
2. In addition to utility marker tape, PVC and HDPE force main shall have a tracer wire installed along the top of the pipe. The wire shall be insulated, no smaller than 12 gauge, and for underground applications.
3. Splices in wiring shall be made with epoxy/silicon splice connector.
4. Tracer wire shall be installed along the top of service laterals. The wire shall have HDPE insulation, be no smaller than 12 gauge, and intended for underground applications. The tracer wire shall be green in color. Tracer wires shall terminate at

the ground surface inside a tracer box. Tracer box lids shall be green in color. Tracer wire shall be grounded to a minimum one pound magnesium anode at the sewer line.

## **3502 CONSTRUCTION AND INSTALLATION**

### **A. General**

#### **1. Notification**

##### **a. Disruption of Sanitary Sewer Service:**

- i. When a disruption of sanitary sewer service will occur, the Contractor shall notify Water Utilities Operations at least 48 hours in advance to make the necessary arrangements.
- ii. It shall be the Contractor's responsibility to place door hangers on the affected premises at least 24 hours in advance of the disruption. The door hanger shall indicate the date and time of the disruption and its anticipated length.

##### **b. The Contractor's work shall be scheduled in a manner to accommodate the schedules of the City and the affected customers.**

#### **2. Protection of Existing Water Mains, Sewers, Structures, or Utilities**

- a. Where new lines approach, cross, connect to, or run parallel to existing water or sewer mains, the Contractor shall be held completely responsible for protecting, preserving, and otherwise maintaining existing line during construction of new line. Any damage inflicted to water and sanitary sewer mains or structures must be promptly reported to Water Utilities Operations and arrangement made for the repair. Any damage inflicted to storm sewer lines or structures must be reported promptly to the Public Works Operations Division and arrangement made for repair. Any damage inflicted to any other utility must be reported promptly to the respective utility and arrangement made for the repair.
- b. Where new construction interferes with operation of existing mains, Contractor shall provide bypass lines or other temporary connections are required to maintain continuous service.
- c. The Contractor shall protect all existing structures, utilities, and work of any kind against damage or interruption of service that may result from the operations of the Contractor. Damage or interruption of service resulting from failure to do so shall be repaired or restored promptly at the expense of the Contractor.
- d. The Contractor shall give reasonable notice to utility companies and to other owners of property when such property is liable to damage or injury could result

from the execution of the Work, so that the owners of such utility or property may take precautionary measures.

- e. The Contractor shall be responsible to adjust to finish grade any existing utility/appurtenances (i.e. valves, meter wells, sanitary sewer manhole, storm junction box etc.) that is affected by construction.

### 3. Handling and Storage

- a. Handle pipe materials and fittings in a manner to assure installation in sound and undamaged condition. Use slings, lifting bags, hooks, and other devices designed to protect pipe, joint elements, and coatings. In handling plastic pipe of 10 feet long or greater, a double sling will be required.
- b. Ship, move, and store with provisions to prevent movement or shock contact with adjacent units.
- c. Pipe shall be handled in a manner that minimizes the damage to the coating. Damaged coating shall be repaired in a manner complying with the pipe manufacturer's recommendations.

4. Inspection of Materials: All pipe, fittings, and accessories shall be examined by the Inspector prior to installation for soundness and specification compliance. Rejected materials shall be marked and removed from the project site, and replaced with approved materials.

5. Alignment: Pipe shall be laid to the lines and grades as shown on the approved Engineering Plans.

6. Cleaning: All pipe, fittings, and accessories shall be kept clean of foreign matter while being handled or stored. During installation, foreign matter shall not enter the pipe or appurtenances. At the end of each working day, a temporary plug shall be installed at the termination of the pipeline.

## B. Sanitary Sewer Installation

1. Installation Standards: All pipes shall be installed in accordance with the following standards:

- a. DIP - ANSI/AWWA C 600.
- b. PVC Pipe - ASTM D 2321.
- c. HDPE Pipe - Plastics Pipe Institute, "Underground Installation of Polyethylene Pipe".

2. Installation

- a. Governmental Requirements: Sanitary sewer main installation shall comply with applicable local, State, and Federal requirements.
- b. Trench Dewatering: See Section 2100.
- c. Drainage Course Crossings: See Section 2100.
- d. Trench Widths
  - i. Minimum Widths: Trench widths and pipe clearances shall be not less than those shown in the following table.

<b>MINIMUM TRENCH WIDTHS AND PIPE CLEARANCES (in)</b>			
<b>Nominal Pipe Diameter</b>	<b>Trench Width<sup>1</sup></b>	<b>Pipe Side Clearance<sup>2</sup> (Soil/Rock)</b>	<b>Pipe Bottom Clearance (Soil/Rock)</b>
6	22	6/6	6/6
8	22	6/6	6/6
10	24	6/6	6/6
12	27	6/6	6/6
15	30	6/6	6/6
18	34	6/6	6/6
21	39	7/9	6/9
24	43	7/9	6/9
27	48	8/9	6/9
30	54	8/9	6/9
<sup>1</sup> Measured below a horizontal plane 6 inches above the top of the pipeline. <sup>2</sup> Measured from the outside face of pipe barrel to inside face of trench.			

- ii. Maximum Widths
  - (a) Maximum trench widths shall not exceed the manufacturer's recommendations.
  - (b) The allowable maximum trench widths hereinafter specified apply only to that portion of the trench below the horizontal plane parallel to and 6 inches above the top of the pipe.
  - (c) The allowable maximum widths may be exceeded at manholes, bore pits, tees, and in unstable earth material. Where the maximum trench width is exceeded, the Contractor shall provide appropriate embedment as indicated by the Design Engineer and the City Engineer.
- iii. Trench Slope: See Section 2100.

- iv. Trench Shields: See Section 2100.
  - e. Compacted Fill: See Section 2100.
  - f. Pipe Embedment: All pipe shall be bedded in bedding material with a minimum thickness beneath the pipe as specified in Paragraph 3502.B.2.d. See Section 2100.
  - g. Bedding Installation: See Section 2100.
3. Backfill: See Section 2100.
4. Utility Marker Tape: Install utility marker tape above the centerline of each sewer line. Bury marker tape 18 to 24 inches below finished grade, along the full length of the sewer line. When tracer wire is required, the tracer wire shall be installed along the top of the pipe so that the wire is in relatively continuous contact with the pipe and shall be for underground applications. The wire shall be accessible at every manhole, vault or tracer box. Marker tape and tracer wire shall be inspected by the public works inspector prior to backfill. All tracer wires shall be tested before acceptance. Any tracer wire broken during installation shall be repaired by the Contractor.
5. Wyes and Building Sewer Stubs: Wyes and building sewer stubs shall be installed as shown on the Engineering Plans or specified herein.
- a. Building sewer stubs shall be adequately plugged to prevent foreign matter from entering the pipe during construction.
  - b. Wyes shall be installed at a maximum of 45 degrees and not less than 30 degrees with pipe spring-line, for pipe sizes 8- through 16-inch diameters. Wyes shall not be installed in pipe sizes equal to or greater than 18 inches in diameter.
  - c. When the building sewer stub grade exceeds 20 percent, pipeline anchors shall be installed as required under Paragraph 6501.E.7 with the first anchor not more than 12 or less than 5 feet upstream of the wye.
  - d. All building sewer stubs shall be constructed bell to spigot.
  - e. For new construction, where a wye has been provided for a private building sewer, a second wye shall not be provided (cut-in by the builder).
  - f. The Contractor shall maintain an accurate record for submittal to the Design Engineer of location, size, and direction of each wye and insertable fitting and the elevation, location, size, and length of each building sewer stub. Locations shall use the pipeline stationing as shown on the Engineering Plans.
6. Gravity Sewers: All gravity sewers shall be installed to the alignment, elevation, slope, and with pipe embedment as specified and/or shown on the Engineering Plans.
7. Pipe Encasement, Collars, Anchors, and Trench Checks

- a. Concrete construction shall comply with ACI 301, Specifications for Structural Concrete.
  - b. Total or partial encasement of pipe in concrete shall be used where the required safe supporting strength of the pipe cannot be obtained by other bedding methods. Concrete encasement shall also be provided at locations to protect public water supplies or where there exists the possibility that standard bedding may be eroded by currents of water under and around the pipe.
  - c. Concrete encasement shall be constructed at locations indicated and in accordance with details as shown on the Engineering Plans and in the Standard Drawings. Start and terminate encasement at a pipe joint. Adequately support and block the pipe to maintain position and prevent flotation. Form to dimensions indicated or construct full width of a trench.
    - i. Longitudinal reinforcement shall be continuous.
    - ii. Concrete encasement shall be protected and cured so as to prevent excessive evaporation of moisture or freezing. Backfilling will not be considered as a suitable method of curing the encasement.
    - iii. Backfill trench only after concrete encasement has obtained a minimum of 2000 psi. All backfilling shall be done in accordance with Section 2100.
  - d. Collars shall be constructed at locations indicated on and in accordance with details shown on the Engineering Plans and in the Standard Drawings.
  - e. Anchors shall be constructed at locations indicated on and in accordance with details shown on the Engineering Plans and in the Standard Drawings.
  - f. Trench Checks: Trench checks shall be constructed at locations indicated on and in accordance with details shown on the Engineering Plans and in the standard drawings. They shall consist of flowable backfill and extend 12 inches below the bottom of the pipe. Length shall be a minimum of 12 inches and width shall be the width of the trench. The height of the trench check shall extend to 12 inches above the top of the pipe.
8. Pipe Laying: All pipe shall be installed in accordance with the pipe manufacturer's recommendations, except as modified herein.
- a. Pipe laying shall not proceed if the trench width as measured at the top of pipe exceeds the maximum allowable trench width. If this occurs, the Contractor shall submit to the Design Engineer for approval a better bedding for the pipe or pipe of sufficient strength to provide safe supporting strength.
  - b. All pipe and fittings shall be stored and handled with care to prevent damage thereto. Do not use hooks to transport or handle pipe or fittings. Do not drop pipe or fittings.

- c. Pipe and fittings rejected by the Inspector shall be marked and removed from the project site. All pipe and fittings shall be examined for soundness and specification compliance prior to placement in the trench and rejected pipe or fittings shall not be incorporated into the pipeline. Check the class or pipe strength to be sure proper pipe is installed.
- d. Clean joint contact surfaces prior to jointing. Use lubricants, primers, or adhesives as recommended by the pipe or joint manufacturer. Keep lubricants and applicators clean.
- e. Pipe laying shall begin at the lowest point. The Contractor will not be allowed to lay any pipe if manholes are not on the project site. The pipe laying upstream of a manhole shall not proceed until the base of the manhole has been placed and leveled.
- f. Unless otherwise required, lay all pipe straight between manholes. Excavate bell holes for each pipe joint. When jointed, the pipe shall form a true and smooth pipeline.
- g. The alignment of all pipelines between adjacent manholes shall be true to line and grade. The pipeline from manhole to manhole shall reflect the full bore of the pipe. The pipe shall be truly centered into the abutting pipe.
- h. The grade lines shown on the profile drawings extend from the centerline of the top manhole to the centerline of the bottom manhole. The pipes and appurtenances shall be truly laid to line and grade throughout, all junctions and other pieces required shall be properly excavated for and laid as shown on the Engineering Plans, and the following tolerances from true horizontal alignment and vertical grade shall be maintained:

Horizontal Alignment:	$\pm 12$ inches
Vertical Grade:	$\pm 0.1$ feet

Pipe installed but not meeting these tolerances shall be ordered removed and replaced at the Contractor's expense.

- i. The sewer trench shall be excavated to sufficient depth to allow embedment to be placed in the bottom of all trenches. At the pipe joints, the trench shall be excavated to an additional depth so that the bell will not rest on the bottom of the trench, and all the weight of the pipe shall be evenly distributed along the entire length of the barrel of the pipe.
- j. The sewer must be made watertight at all points; any leaks or other defects discovered at any time before the final acceptance of the Work shall be immediately repaired or that portion of the sewer shall be rebuilt if necessary.
- k. In all cases, full length sticks of pipe shall be used, except in making closures.

- l. Clean interior of all pipe, fittings, and joints prior to installation. To exclude entrance of foreign matter during discontinuance of installation, close open ends of pipe with snug fitting closures. Take reasonable precautions to not let water fill the open trench, and include provisions to prevent pipe flotation. Remove water, sand, mud, and other undesirable backfill materials from trench before removal of end cap.
- m. In forming joints, each length of pipe shall be carefully aligned in such manner as to form an accurate concentric joint, thus providing a uniform circular pipe opening. Each length of pipe shall thrust into the bell and shall be securely held in position until the next length of pipe has been placed. Insofar as possible, commence laying of downstream end of line and install pipe with spigot or tongue end downstream.
- n. The pipeline trench excavation shall be dewatered sufficiently to allow pipe joints to be made under dry conditions. No joints shall be made under water.
- o. Joints:
  - i. Joints shall in general be made in accordance with the manufacturer's recommendations and as specified herein. All joints to be welded or fused shall be performed by a technician certified by the manufacturer.
  - ii. Clean and lubricate all joint and gasket surfaces with lubricant recommended by pipe manufacturer.
  - iii. Care shall be exercised by the Contractor to insure against damage to joint material in storage, handling, or placing operations.
  - iv. No damaged joint material shall be permitted to be used, and the same shall be removed from the job site.
  - v. All pipe joints shall be completed by insuring that the ends of the pipe to be joined are in contact and completely shoved into "home" position.
- p. Pipe shall be cut in a neat workmanlike manner without damage to pipe. Cutting of pipe with a torch is not permitted. Smooth cut by power grinding to remove burrs and sharp edges. Repair the lining as required and approved by the Inspector.
- q. All pipelines shall be plugged at the end of each day's progress. Plugs or other positive methods of sealing shall be utilized at all times to protect any existing system from entrance of storm water or other foreign matter.
- r. When a sanitary sewer line crosses an existing pipeline (water lines and storm), and the clearance is less than 18 inches, concrete encasement shall be required in a manner approved by the City's on-site representative.

## 9. Temporary Plugs

- a. Provide and install plugs as manufactured by pipe supplier or as fabricated by Contractor if approved. Plugs shall be watertight against hydraulic heads up to 20 feet. Secure plugs in place in a manner that facilitates removal when required to connect pipe.
  - b. Plugs shall be installed as specified or where shown on Engineering Plans. Also the open end of the sewer shall be plugged at the end of the work day with a suitable mechanical plug to prevent entry of foreign material until work is resumed.
10. Removal of Water: The Contractor shall provide dewatering as specified in Section 2100. Damaged pipe or structures of any kind resulting from insufficient dewatering facilities or similar lack of proper conduct of the work shall be replaced by the Contractor at their own expense. No structure or pipes shall be laid in water, and no water shall be allowed to run into or over any concrete work or pipe, or into or through any pipe.
11. Sewer Main Connections to Existing Pipelines and Structures
- a. General: Connect pipe to existing structures and pipelines where indicated.
  - b. Tying a Sewer Main to an Existing Manhole: Prepare structure by making an opening with manufacturer's recommended clearance all around fitting to be inserted. The concrete structure shall be core drilled, and a flexible pipe-to-manhole connector/gasket shall be installed in such a manner that a watertight condition will result. Refer to the Water Utilities list of Acceptable Manufacturers and Models for flexible pipe-to-manhole connectors/gaskets.
  - c. Adding a Manhole onto an Existing Sewer Main:
    - i. The Contractor shall cut the existing sewer main, set a pre-cast base onto a 6-inch thick (minimum) crushed rock bedding layer, and insert sewer pipe through the manhole to connect the existing ends of the sewer main. The ends may be connected to the existing sewer through the use of rigid couplings if a bell(s) is (are) not available. The inverts may be formed using non-calcium chloride high-early strength concrete.
    - ii. Any portion of the existing sewer damaged by the Contractor shall be repaired or replaced. Any damaged vitrified clay pipe shall be replaced with PVC pipe, as a minimum, or DIP if required by its location.
    - iii. Bypass pumping shall be required and shall be coordinated with Public Works Inspections.
  - d. Pipe Connecting to a Structure: Pipe connecting to a structure shall be supported with bedding aggregate as specified in Section 2100.

12. Connection of Pipes of Dissimilar Materials:

- a. General: The connection of pipes of different materials shall be made using approved transition couplings, and shall provide a permanent and watertight connection that will withstand the hydrostatic test pressure.
- b. Pipe Diameters less than 15 Inches: Connections between different pipe materials less than 15 inches in diameter shall be made using a Fernco Strong Back coupling or approved equal unless otherwise specified on the Engineering Plans. Refer to the Water Utilities List of Acceptable Manufacturers and Models.
- c. Pipe Diameters Greater than or Equal to 15 Inches: Connections between different pipe materials greater than or equal to 15 inches in diameter shall be made using a Fernco Strong Back coupling. The coupling shall be encased in MCIB/KCMMB 4000 psi concrete mix to a level 6 inches above the top of the pipe material unless otherwise specified on the Engineering Plans.

### 13. Abandonment of Sewer Mains and Building Sewer Stubs

- a. Building Sewer Stubs shall be abandoned when buildings are demolished and there are no re-development plans to reuse the existing sewer stubs.
- b. Prior to abandonment of a sewer main, the Contractor shall verify that no existing services will be affected. Building sewer stubs shall be properly abandoned prior to abandoning the sewer main.
- c. If a sewer main is indicated for abandonment, it shall be abandoned by removal and backfill if required or by plugging each end of the line segment with a 1-foot thick plug of non-shrink grout sealed with a Portland cement grout.
- d. If the building sewer stub to be abandoned is connected to a VCP sewer main with a wye, a short piece of pipe is left in the end of the wye, the pipe is plugged with an expandable plug, and the plug is encased with concrete. If the building sewer stub to be abandoned is connected to a VCP sewer main via a break-in connection, the building sewer stub is removed from the main and the hole is plugged with a stainless steel full-circle repair clamp.
- e. If the building sewer stub to be abandoned is connected to a PVC sewer main with an in-line wye or tee, the building sewer stub is removed, and a PVC plug is installed on the end of the wye/tee. If the building sewer stub to be abandoned is connected to a PVC sewer main via a saddle connection, the building sewer stub is removed from the main, and the hole is plugged with a stainless steel full-circle repair clamp.

### 14. Protection of Water Supplies

- a. There shall be no physical connection between a public or private potable water supply system and a sewer, or an appurtenance thereto, that would permit the passage of any wastewater or polluted water into the potable water supply.

- b. Sewer mains, i.e., house connections, building sewers, truck lines, interceptors, force mains, etc., shall not be constructed within a 100-foot radius of a public water supply well. Greater separation may be required where soil and drainage conditions indicate the need for greater protection. Sewer mains constructed of DIP may be constructed within 10 feet of a private water supply well. Sewer mains constructed of other materials must be at least 50 feet from a private water supply well.
- c. For sewer mains paralleling or crossing water mains, see Paragraph 6501.E.1.c.
- d. Water and sewer mains shall not be placed in the same trench or excavation.

### C. Acceptance Tests for Completed Sewers

#### 1. General

- a. The Contractor shall furnish all labor, equipment, water, materials, and reports for the required acceptance tests. All pipelines, including building sewer stubs, shall undergo and pass all required tests to determine soundness and workmanship. Pipelines that do not comply with the City of Lee's Summit Standard Specifications shall be repaired and/or replaced and shall be retested until the pipeline meets said specifications.
  - b. No testing shall be performed before backfill and compaction operations have been completed unless otherwise approved by the Inspector. In general, testing for sanitary sewers shall begin at least 30 days after completion of the sanitary sewer.
  - c. After backfilling has been completed, the Contractor shall conduct all testing in the presence of the Inspector.
  - d. Each reach of sewer shall meet the requirements of the acceptance tests. All defects shall be repaired to the satisfaction of the Inspector.
  - e. The Contractor shall clean and flush with clear water the pipe of excess mortar, joint sealant, and other dirt and debris prior to inspection.
2. Sewer Pipe Alignment and Grade Testing: Alignment, grade and visible defects shall be checked as follows:
- a. Sewer Pipe Deflection Testing: Flexible pipelines (i.e., PVC pipe) shall be tested for deflection by pulling a mandrel through the entire length thereof.
    - i. The mandrel (go/no-go) device shall be cylindrical in shape and constructed with nine evenly-spaced arms or prongs. Mandrels with fewer arms will be rejected as not sufficiently accurate. The dimensions of the mandrel shall be as listed in the table below. The mandrel diameter dimension shall carry a tolerance of  $\pm 0.01$  inch. Allowances for pipe wall thickness tolerances or ovality (from heat, shipping, poor production, etc.) shall not be deducted

from the mandrel diameter dimension but shall be counted in as part of the 5 percent or lesser deflection allowance. Contact length shall be measured between points of contact on the mandrel arm. The length shall not be less than as shown in the table below.

Nominal Diameter (in)	Mandrel Length (in)	Mandrel Diameter (in) <sup>1</sup>	
		SDR 26 <sup>2</sup>	SDR 21 <sup>3</sup>
8	8	7.37	7.41
10	9	9.21	9.21
12	10	10.96	10.96
15	12	13.42	N/A
18	15	N/A	15.47
21	16	N/A	N/A
24	18	N/A	20.63
27	27	N/A	N/A

<sup>1</sup> Mandrel diameter = [avg. outside diameter - 2\*(min. wall thickness)]\*0.95

<sup>2</sup> Calculated using values from ASTM D3034.

<sup>3</sup> Calculated using values from ASTM D2241.

- ii. The Inspector shall be responsible for approving the mandrel. In the event the Contractor provides the mandrel, he/she shall provide proving rings to verify this. No mandrel testing will be witnessed or approved by the Inspector without completion of the aforementioned verification of the mandrel size for the Work.
  - iii. The mandrel shall be hand-pulled by the Contractor through all sections of PVC sewer mains. Any sections of sewer not passing the mandrel test shall be uncovered, and the Contractor shall re-round or replace the sewer to the satisfaction of the Inspector. These repaired sections shall be retested.
  - iv. Sections of DIP sewer main shall be visually checked for deflection, i.e., not deflection tested with the mandrel due to the potential for damaging the cement mortar lining.
- b. Television Inspection: Sewer mains installed as part of the Work are subject to inspection by closed circuit television prior to 1) issuing a Certificate of Substantial Completion and 2) the end of the correction period. Television inspection will be done by the City at the City's expense. Any deficiencies noted shall be repaired at the expense of the Contractor.
3. Exfiltration-Infiltration Testing
- a. General

- i. Air pressure or hydrostatic tests shall be conducted on sewers before acceptance by the City. The exfiltration-infiltration shall not exceed 50 gallons per day per inch of nominal diameter per mile of sewer main for any section of the Work.
  - ii. Immediately prior to conducting a test, the groundwater level shall be determined by augering a vertical hole adjacent to the pipe and measuring the distance to the water level. Exfiltration head and air test pressures shall be adjusted for groundwater elevations over the top of the pipe.
- b. Sewer Pipe Exfiltration Testing: Exfiltration tests shall be performed by the Contractor using one or a combination of the methods as set forth below. The required air pressure and/or exfiltration testing shall be successfully performed on carrier conduits prior to sealing of the ends of the casing conduits. PVC gravity sewer pipe shall be air tested.
- i. Air Testing for PVC and DIP Gravity Sewer Mains
    - (a) The Contractor may perform air tests for all pipe sizes.
    - (b) Furnish all facilities required including necessary piping connection, test pumping equipment, pressure gauges, bulkheads, regulators to avoid over pressurization, and all miscellaneous items required.
    - (c) Each section of gravity pipeline between manholes and/or structures shall be tested after backfilling as outlined below and in accordance with ASTM F 1417. The time-pressure drop method specified in 8.2.2 of ASTM F 1417 shall be used.
    - (d) If the groundwater level is 2 feet or more above the top of the upstream end or if the test pressure required for the test is more than 9 psig, air testing should not be used.
    - (e) The pipe plug for introducing air to the sewer main shall be equipped with two taps. One tap will be used to introduce air into the line being tested through suitable valves and fittings, so that the input air may be regulated. The second tap will be fitted with valves and fittings to accept a pressure test gauge indicating internal pressure in the sewer pipe. Additional valves and fitting will be incorporated on the tap used to check internal pressure so that a second test gauge may be attached to the internal pressure tap. The pressure test gauge will also be used to indicate loss of air pressure due to leaks in the sewer main.
    - (f) The pressure test gauge shall meet the following minimum specifications:

Size (diameter)	4-1/2 inches
Pressure Range	0-15 psi
Figure Intervals	1 psi increments

Minor Subdivisions	0.05 psi
Pressure Tube	Bourdon Tube or diaphragm
Accuracy	+/-0.25% of maximum scale reading
Dial	White coated aluminum with black lettering, 270° arc and mirror edge
Pipe Connection	Low male ½-inch N.P.T.

Calibration data not more than one year old shall be supplied with all pressure test gauges. Certification of pressure test gauges will be required from the gauge manufacturer. This certification and calibration data shall be given to the Inspector prior to the performance of any air tests conducted for the Work.

- (g) Plug ends of line and cap or plug all connections to withstand internal pressure. Due to safety considerations, the Contractor must take care to brace both the end of the pipe and plug before introducing test pressure into the system. The Contractor can then connect the air control equipment to the air hose and begin to pressurize the system. During the pressurization process, the Contractor shall monitor the air pressure of the system so that internal pressure does not exceed 5.0 pounds per square inch gauge (psig). After reaching 4.0 psig, throttle the air supply to maintain between 4.0 and 3.5 psig for at least 2 minutes in order to allow equilibrium between air temperature and pipe walls. During this time, check all plugs to detect any leakage. If plugs are found to leak, bleed off air, tighten plugs, and again begin supplying air. After temperature has stabilized, the pressure is allowed to decrease to 3.5 psig. At 3.5 psig, begin timing to determine the time required for pressure to drop to 2.5 psig. If the pressure begins to slowly drop from 3.5 psig and if the total time, in seconds, for the air pressure to decrease from 3.5 psig to 2.5 psig is greater than that shown in the table below, the pipe shall be presumed free of defects.

<b>Pipe Size (in)</b>	<b>Minimum Time (min:s)</b>	<b>Length for Minimum Time (ft)</b>	<b>Time for Longer Length (s) L = Total Length</b>
8	7:34	298	1.520 L
10	9:26	239	2.374 L
12	11:20	199	3.418 L
15	14:10	159	5.342 L
18	17:00	133	7.692 L
21	19:50	114	10.470 L
24	22:40	99	13.674 L
27	25:30	88	17.306 L
30	28:20	80	21.366 L

If air test fails to meet above requirements, repeat the test as necessary after all leaks and defects have been repaired and backfilled.

- ii. Hydrostatic Tests for Gravity Systems:

- (a) Test section shall be filled with water not less than 12 hours prior to testing. Refill the test section of pipe prior to performing the test.
  - (b) Perform at depths of water as measured above center line of pipe of not less than 4 feet or more than 10 feet (consideration shall be given for a water table above said centerline). Maintain the test as necessary to locate all leaks but not less than two hours.
  - (c) The Design Engineer shall determine the maximum allowable exfiltration rate for a given test section and then field verify that the maximum exfiltration rate has not been exceeded for that section. The maximum allowable exfiltration rate shall be approved by the City Engineer prior to testing.
- c. Sewer Pipe Infiltration Testing: Where sewers are laid within the groundwater table, infiltration testing shall be conducted. Where the Inspector discovers evidence of infiltration, the Design Engineer and the City Engineer shall be contacted. The Contractor shall install weirs or other suitable flow rate measuring devices adequate to determine to the satisfaction of the City Engineer that the specified infiltration limit is not exceeded for that reach of gravity sewer. Where the specified infiltration limit is exceeded, the Contractor shall repair or replace the defective reach of the pipeline. Following repair of the pipeline, the Contractor shall re-measure infiltration flow rates and make additional repairs until an acceptable infiltration flow rate is achieved.

D. Manhole Installation:

1. Bases

- a. Integral cast bases shall be reinforced in accordance with ASTM C 478. Precast integral cast bases shall be installed on a maximum of 6 inches of bedding aggregate. Depths exceeding this amount shall be filled with MCIB/KCMMB 4000 psi concrete mix.
- b. If integral cast bases cannot be used, cast-in-place concrete bases shall be used with the approval of the City Engineer. Cast-in-place bases shall be MCIB/KCMMB 4000 psi concrete mix and have a minimum thickness of 12 inches. The bottom wall sections shall be embedded in the base section a minimum of 4 inches. The bottom precast wall section shall not be set upon a previously poured base. Wood shall not be used for supporting or leveling the wall section prior to pouring the base.

2. Inside Dimensions: The minimum horizontal clear distance in the barrel of the manholes shall not be less than 4 feet.

3. Precast

- a. Delivery: Precast concrete components shall not be delivered to the job until representative concrete control cylinders have attained at least 80 percent of the specified minimum design strength.
  - b. Inspection: Precast concrete shall be inspected when delivered. Rejection of defective or cracked precast concrete components shall be in accordance with ASTM C 478.
  - c. Construction: Precast sections shall be cleaned of all dirt, grass, and other deleterious matter. Seal wall and cone joints with a minimum of two beads of preformed butyl joint sealant. Seal the joints between the top of the cone, adjustment or riser rings and the manhole frame with a double bead of preformed butyl joint sealant. Sections shall be placed so that steps are aligned but without rotation or damage to sealant integrity. Lift holes in excess of 2 inches in depth shall be patched with non-shrink grout.
4. Cast-in-Place:
- a. Wall Thickness: Wall thickness shall conform to the dimensions as shown on the Engineering Plans.
  - b. Construction: Reinforcement steel shall be placed as shown on the Engineering Plans. Tie-holes shall be patched with non-shrink grout. Wall sleeves, where required, shall be installed as shown on the Engineering Plans. Water stops shall be installed at the wall and slab connection and shall be of the size, thickness, and material shown on the Engineering Plans.
  - c. Waterproofing: Interior protective coatings, where required, shall conform to the material specifications. Application shall conform to the manufacturer's recommendation.
5. Sealants. A double bead of preformed butyl joint sealer shall be applied to all joints. For the minimum bead dimension, see Paragraph 3501.O.4. The vertical spacing between manhole sections shall not exceed 1/4 inch. Joint sealants shall not be applied on damp or dirty surfaces.
6. Joint Wraps: The exterior of all joints, including the frame and cover assembly, shall be sealed with a 6-inch wide butyl joint wrap with rubber backing. Refer to the Water Utilities List of Acceptable Manufacturers and Models. The tape shall be overlapped at least twice its width. The tape shall not be stretched during application. Primer and/or adhesive, as recommended by the tape supplier, shall be employed for adverse, critical, or other applications.
7. Epoxy Manhole Liner: Installation of epoxy manhole liner shall consist of: cleaning the entire manhole interior surface, preparation of the manhole interior surface, frame seal, grade adjustment, cone/wall joint, pipe seals, bench and invert as required, and lining the manhole interior surface with a two component, 100% solids epoxy coating system which provides a durable, high strength, monolithic lining, at an average

thickness of 125 mils with a minimum thickness of 120 mils. The first two manholes downstream of a force main entering the system shall be lined along with any other manholes identified on the Engineering Plans.

8. Gaskets. When gaskets are used, two gasket clamps shall be utilized at each pipe-to-gasket connection with the take-up screws for the gasket clamps being positioned a minimum of 90° apart.
9. Steps: Steps shall be aligned vertically below the casting and spaced at 16-inch centers. The top step shall be not more than 1 foot below the top of the cone. The lowest step shall be not more than 1 foot above the invert bench. Field drilled step holes are not permitted in precast concrete manholes unless approved by the Inspector.
10. Castings:
  - a. Castings shall be installed with the mud ring inserted inside the manhole opening and resting on a minimum of two rows of preformed butyl joint sealant.
  - b. Bolt-down castings shall be held in place as shown on the Engineering Plans.
  - c. Bolt-down castings shall be bolted to the manhole, not to the adjusting ring.
11. Top Slabs: Thickness shall conform to the dimensions and reinforcement steel shall be placed as shown on the Engineering Plans.
12. Inverts: Inverts shall be at least MCIB/KCMMB 4000 psi concrete mix and steel-troweled to produce a dense, smooth finish. The invert channel shall be "U" shaped in cross section and extend upward three-fourths of the inside pipe diameter. Smooth transitions shall be formed for pipes of different sizes, elevation, and bends. The invert bench shall be sloped to drain. In no case shall the inverts extend into the pipe. Manholes with precast inverts shall not be used, except as allowed in Paragraph 6501.H.10.a.
13. Top Elevation: The finish top elevation of manhole castings shall conform to the following unless otherwise shown on the Engineering Plans or directed by the Inspector.
  - a. In paved or future paved areas, the top of the casting shall conform to the slope of the pavement and be 1/8 inch below the finished pavement elevation.
  - b. In non-pavement areas, the top of the casting shall be at the elevation shown on the Engineering Plans or as directed by the Inspector.
14. Manhole Adjustment: All new manholes will be provided with an adjustment ring(s) underneath the casting as shown on Engineering Plans. A maximum of two 6-inch or three 4-inch riser rings shall be installed on top of the cone section. Minimize the number of riser rings used. The joints shall be sealed with a double bead of preformed butyl joint sealant. If the top of an existing manhole is required to be raised to an

elevation that will exceed 12 inches, or lowered more than the adjustment rings will allow, all vertical adjustments shall be made to the barrel of the manhole.

15. Manhole Backfilling: Manhole backfilling shall be governed by Section 2100. Any damage to the exterior manhole waterproofing shall be coated with 14.0 mils of bituminous coating prior to backfilling.

E. Acceptance Testing for Completed Manholes

1. General: All manholes and other structures installed or otherwise disturbed during construction shall be tested for infiltration-exfiltration by the method described herein. Infiltration-exfiltration testing shall be performed in the presence of the Inspector. The Contractor shall notify the Inspector 2 working days prior to beginning manhole testing. All visible leaks shall be repaired by the Contractor prior to testing and during the correction period.

2. Infiltration-Exfiltration Testing:

- a. For new manholes, lift holes penetrating the manhole wall in excess of 2 inches in depth shall be plugged with an approved non-shrink grout prior to testing. All pipes entering the manhole shall be plugged at least 8 inches into the sewer pipe. The plug shall be inflated at a location beyond the manhole/pipe. The plug and pipe shall be braced securely to prevent either item from being drawn into the manhole.
- b. Test Method: The vacuum test apparatus shall be placed inside or on top of the casting and the seal inflated according to manufacturer's directions as appropriate. A vacuum of 10 inches of mercury shall be drawn, and then the vacuum pump shall be shut off. With valves closed and hoses removed, the time shall be measured for the vacuum to drop to 9 inches of mercury. The manhole shall be acceptable if the time for the vacuum to drop from 10 inches to 9 inches is as follows:

<b>Manhole Depth</b>	<b>Time (min)</b>
10 feet or less	2.0
10.1 to 15.0 feet	2.5
15.1 to 25 feet	3.0
25.1 feet or greater	3.5

- c. Resealing, repairs, and retesting shall be allowed at the discretion of the Inspector.
- d. If the manhole fails the initial test, necessary repairs shall be made with a water reactive elastomeric chemical grout, such as 3M Scotch Seal Chemical Grout 5600, or a water reactive polymer solution, such as Avanti AV-202, or equivalent. Resealing and retesting shall be performed until the manhole passes the test.

### **3503 ACCEPTABLE MANUFACTURERS AND MODELS**

- A. General: A list of acceptable manufacturers and models for various materials will be maintained by the City Engineer and updated on a regular basis. An approved list of materials can be found on the City's web site [www.cityofls.net](http://www.cityofls.net). Go to Development, then Development Regulations, then Design and Construction Manual.