

SECTION 3000 MATERIALS AND CONSTRUCTION - SANITARY SEWERS

3001 GENERAL:

This section governs materials that may be required to complete pipeline construction, exclusive of structures, as shown on the Plans and/or as provided in the Special Provisions.

3002 SPECIFICATION MODIFICATIONS:

It is understood that throughout this section these specifications may be modified or deleted by appropriate items in the contract drawings or Special Conditions.

3003 REVISIONS OF STANDARDS:

When reference is made to a Standard Specification, i.e. ASTM, ANSI, AWWA, KCMMB, the specification referred to shall be understood to mean the latest revision of said specification as amended at the time of the Notice to Bidders, except as noted on the Plans or in the Special Provisions.

3004 MATERIALS AND TESTING:

Furnish pipe of materials, joint types, sizes, and strength classes indicated and specified. Higher strengths may be furnished at the Contractor's option and at no additional cost to the Owner.

The manufacturer shall be experienced in the design, manufacture and commercial supplying of the specific material.

Testing is to be performed by the Manufacturer's quality control personnel in conformance with applicable standards. Testing may be witnessed by Owner, or approved independent testing laboratory. The Contractor shall provide three (3) copies of certified test reports indicating that the material does conform to the specifications.

Handling: The manufacturer and contractor shall use equipment and methods adequate to protect pipe, joint elements and prevent shock contact of adjacent units during moving or storage. Damaged sections that cause reasonable doubt as to their structural strength or water tightness will be rejected. No pipe or fitting shall be delivered until approved by the said Materials Laboratory and are so marked.

3005 HIGH DENSITY POLYETHYLENE PIPE (HDPE):

General: High Density Polyethylene Pipe (HDPE) and fittings shall conform to ASTM F714, ASTM D-1248, ASTM D-3550, except as otherwise noted herein. Furnish maximum lengths manufactured by supplier, except for fittings, closures and specials. All HDPE pipe shall be marked with a green stripe to signify its use for sanitary sewer facilities.

3006 DUCTILE-IRON PIPE:

Ductile Iron Pipe shall be used only where structural concerns are paramount and corrosive conditions do not exist. Material shall conform to ANSI A21.51; ASTM A536, Grade 60-42-10, except as otherwise noted herein.

- A. Design. Design of pipe shall be in accordance with ANSI A21.50 laying conditions S, Type 2 or 3. Minimum wall thickness shall be Class 50. Polyethylene Encasement is not permitted.
- B. Joints. Mechanical and push-on joints for ductile-iron pipe and fittings shall

conform to the requirements of ANSI A21.11. Gaskets shall be neoprene or other synthetic rubber material. Natural rubber gaskets will not be acceptable.

- C. Fittings. Fittings shall be in accordance with ANSI A21.10/*AWWA C 110* and shall have a pressure rating of not less than that specified for pipe. Fittings used with ductile-iron pipe shall be ductile-iron or cast iron. Fittings for pipe with mechanical joints shall have mechanical joints. Fittings for pipe with push-on joints shall be either mechanical joint or push-on joint.
- D. Lining & Coating. All ductile-iron pipe, fittings and specials shall be cement mortar lined in accordance with ANSI A21.51. Coat all pipe, fittings and specials with manufacturer's standard coal tar coating.

3007 POLY VINYL CHLORIDE (PVC) SEWER PIPE:

Conform to ASTM D3034, except as otherwise specified herein.

- A. General. Furnish maximum pipe lengths manufactured by the supplier, except for fitting, closures and specials.
- B. Design. The minimum wall thickness for PVC Pipe shall conform to SDR-35 (SDR-26 for stub lines). PVC Material shall conform to ASTM D1784 and shall have a cell classification of 12454-B, 12454-C, 12364-C, or 13364-B.
- C. Joints. Flexible gasketed joints shall be compression type with a gasket confined in a machined groove in the spigot end of the pipe. Oil resistant rubber gasket rings shall conform to the requirements of ASTM D 1869. Gaskets shall be neoprene or other synthetic material. Natural rubber gaskets will not be acceptable.
- D. Fittings. Fittings defined as tee or wye connections suitable for assembly to 4-inch or 6-inch house or building sewers shall be saddle-type fittings molded of PVC plastic.

3008 CONCRETE:

Concrete, whether reinforced or non-reinforced, shall conform to the requirements set forth in Section 2000 "Concrete".

3009 REINFORCING STEEL:

Reinforcing steel shall be placed as shown on the plans and shall conform to ASTM Specifications as follows:

- A. Bars and rods shall be deformed billet-steel conforming to ASTM A 615, Grade 40.
- B. Welded wire fabric shall conform to ASTM A 185, Grade 40.
- C. Fabricated steel bar and rod mats shall conform to ASTM A 184. Bar material shall conform to ASTM A 615, Grade 40.
- D. Smooth bars shall be round carbon steel bars conforming to ASTM A 306, Grade 60.

3010 MANHOLE MATERIALS:

- A. General. Manholes shall conform to the Standard Drawings included in these specifications.
- B. Pre-cast Concrete. Pre-cast concrete manholes shall conform to ASTM C 478. Joints shall be of material as specified for reinforced concrete pipe joints or a bitumastic material or preformed flexible joint sealants applied in accordance with manufacturer's recommendations.
- C. Waterproofing. Waterproofing will be required on all manholes. The bitumen shall consist of two coats of Koppers Bitumastic No. 50 or approved equal. Pre-cast manholes shall be shop coated.
- D. Sealed Joints: All manholes shall be sealed at the joints. The casting shall be sealed to the structure with an external sealing system as manufactured by Sealing Systems, Inc. or approved equal. The seal shall be a continuous band made of high quality 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 of the band. The mastic shall be non-hardening butyl rubber sealant, with a minimum thickness of 3/16", and shall seal to the cone/top of the manhole section and over the flange of the casting. The external sealing system shall be installed according to the manufacturer's recommendations.

3011 MANHOLE FRAMES RINGS AND COVERS:

All covers shall have "Liberty – Sewer" cast or molded onto the top surface. No other wording shall be visible on the surface of the manhole.

- A. Cast Iron.
 - a. Standard Manholes shall utilize Clay and Bailey No. 2008BV, Deeter No. 1315, or approved equal.
 - b. Shallow manholes shall utilize Clay & Bailey No. 2020, Deeter No. 2016 or approved equal.

When bolt-down type manhole rings and covers are required and specified, Clay and Bailey No. 2014, Deeter 1310 or approved equal, with rubber gaskets and stainless steel cover bolts 5/8-inch diameter with hexagonal-head bolts shall be furnished. Bolt-down type manhole rings shall be anchored to the manhole with not less than four (4) 3/4-inch diameter anchor bolts having a minimum of fourteen (14) inches of embedment, (excluding adjustment rings) except in concrete manholes in which the ring is embedded in concrete.

Frame and grade adjustments on all manholes or manholes in paved surfaces shall be sealed with an internal or external rubber chimney seal as manufactured by Crete Specialty Products, or approved equal.

All manhole covers shall be solid and sealed. Rehabilitated manholes shall include a manhole insert per section 3304.

The castings shall meet or exceed the following minimum requirements:

1. Iron castings shall conform to the requirements of ASTM A 48, Class 25.
2. Castings shall be clean and whole, and without blow or sand holes or any other surface defects which would impair serviceability. Plugging or filling of holes or other defects will not be permitted.
3. Parting fins and pouring gates shall be removed.

B. Non-Metallic. All rings and cover units shall be made from high strength nonmetallic fiber reinforced polymer/composite materials. The material shall be a resin thermoset matrix that can be reinforced with continuous E-glass fibers, filament engineered fabrics, fiber rovings, short fiber filaments, or equivalent nonmetallic reinforcing structure(s). The thermosetting resin matrix shall be a polyester, vinylester or a blend of these. The moldings shall be true to pattern in form and dimension and free from cracks, pores, knit-lines or other defects in locations affecting their strength and value for the service intended. Sealing gaskets shall be bonded to the frame continuously at the interface with the cover to reduce wear, shock, noise, malodors and infiltration.

1. Detectability: All Non-Metallic lids shall be detectable by metal detectors. This may be done through the use of embedded magnets or other proven locating means.
2. Load Ratings - Frames, rings and covers intended for traffic service shall be "Proof Tested" in accordance with AASHTO M306: Proof Testing using a load of 50,000 lbs. During the load testing visible cracks or delamination will be cause for rejection. When load is removed, Permanent Set Deflection of more than 1/8" measured at center of load area will be cause for rejection.
3. Ultraviolet Resistance – Specimens shall be tested for resistance to Ultraviolet radiation in accordance with ASTM G154 Cycle 1 for a minimum of 1000 hours. Specimens shall be tested for ultimate flexural strength , retaining at least 75% of control values for load and deflection at failure.
4. Coefficient of Friction – The coefficient of friction shall be greater than 0.6 when tested in accordance with ASTM C1028.
5. Weight - 24" Frames and Covers shall weigh no less than 70 lbs. and no more than 133 lbs. Frame and Cover weight shall not vary more than +/- 3%.
6. Water Tight – Where required composite frames and covers shall be shown to be water tight through the usage of a sealed system utilizing bolts, paddle locks or other approved locking system. Water Resistant systems are not and shall not be accepted in those instances where Water Tight seals are required.

Fabricate rings and covers to conform to shapes, dimensions, and with wording or

logos shown on Utility Drawings.

Installation shall be done in accordance with manufacturers specifications.

3012 BEDDING AGGREGATE:

All crushed stone materials used for pipe bedding shall conform to the requirements of Class I, II, or III and installed as required in ASTM D2321, latest edition. Bedding material shall be placed as indicated in Detail D30-1.

3013 CONSTRUCTION REQUIREMENTS:

A. Grading and Excavation.

1. Scope. Excavation and trenching work shall include the necessary clearing, grubbing, and preparation of the site; removal and disposal of all debris; excavation and trenching as required; the handling, storage, transportation and disposal of all excavated material; all necessary sheeting, shoring and protection work; preparation of subgrades; pumping and dewatering as necessary or required; protection of adjacent property; and other appurtenant work.
2. General. Excavation and trenching work shall be performed in a safe and proper manner with suitable precautions being taken against all hazards. The Contractor shall explore and expose any and all obstructions in advance of excavation so that minor changes in grade and alignment may be made.

In paralleling present water and gas mains, the Contractor shall protect all service connections and shall arrange to furnish service to the consumers with minimum interruption. Door hanger notifications will be furnished by the City and the Contractor shall inform consumers 24 hours in advance of any interrupted service.

All excavated material shall be piled in a manner that will not endanger the work and that will avoid obstructing sidewalks and driveways. Gutters shall be kept clear or other satisfactory provisions made for street drainage.

Siltation and erosion. Construction methods that will minimize siltation and erosion shall be employed. The design engineer shall include in the project specifications the method(s) to be employed in the construction of sewers in or near streams. Such methods shall provide adequate control of siltation and erosion by limiting unnecessary excavation, disturbing or uprooting trees and vegetation, dumping of soil or debris, or pumping siltladen water into the stream. Specifications shall require that clean-up, grading, seeding, planting, or restoration of all work areas shall begin immediately. Exposed areas shall not remain unprotected for more than seven (7) days.

3. Classification of Excavated Material. When specifically indicated in the proposal and contract, classification of excavated materials will be made as follows:
 - a. Rock. Rock excavation will be so classified when sandstone,

limestone, blue shale or other similar material is encountered and, in the opinion of the Engineer, requires drilling or blasting to remove the material.

b. Earth. All material not classified as rock.

4. Clearing. The Contractor shall do all clearing necessary for access, stringing of pipeline materials, and construction of the pipeline and appurtenant structures.
5. Unauthorized Excavation. Any part of the trench excavated below grade shall be corrected with material approved by the Engineer placed and compacted by the Contractor.
6. Dewatering. The Contractor shall provide and maintain adequate dewatering equipment to remove and dispose of all surface and groundwater entering excavations, trenches, or other parts of the work. Each excavation shall be kept dry during sub-grade preparation and continually thereafter until the structure to be built, or the pipe to be installed therein, is completed to the extent that no damage from hydrostatic pressure, flotation or other cause will result.

All excavations for concrete structures or trenches which extend down to or below static groundwater elevations shall be dewatered by lowering and maintaining the groundwater surface beneath such excavations a distance of not less than 12 inches below the bottom of the excavation.

Surface water shall be diverted or otherwise prevented from entering excavated areas or trenches to the greatest extent practicable without causing damage to adjacent property.

The Contractor will be held responsible for the condition of any pipe or conduit which he may use for drainage purposes, and all such pipes or conduit shall be left clean and free of sediment.

7. Sheeting and Shoring. Except where banks are cut back on a stable slope, excavation for structures and trenches shall be properly and substantially sheeted, braced, or shored as necessary to prevent caving or sliding, to provide protection for workmen and the work, and to provide protection for existing structures and facilities. Sheeting, bracing and shoring shall be designed and built to withstand all loads that might be caused by earth movement of pressure and shall be rigid, maintaining shape and position under all circumstances.

Trench sheeting shall not be pulled unless pipe strength is sufficient to carry trench loads based on trench width to the back of sheeting. Sheeting shall not be pulled after backfilling.

Where trench sheeting is left in place, such sheeting shall not be braced against the pipe, but shall be supported in a manner which will preclude

concentrated loads or horizontal thrusts on the pipe. Cross braces installed above the pipe to support sheeting may be removed after pipe embedment has been completed.

8. Stabilization. Trench bottoms shall be firm, dense, and thoroughly compacted and consolidated; shall be free from mud and muck; and shall be sufficiently stable to remain firm and intact under the feet of the workmen.

Trench bottoms which are otherwise solid but which become mucky on top due to construction operations shall be reinforced with one or more layers of crushed stone or gravel. Not more than 1/2 inch depth of mud or muck shall be allowed to remain on stabilized trench bottoms when the pipe bedding material is placed thereon.

9. Trench Excavation. The Contractor shall not open more trenching advance of pipe laying than is necessary to expedite the work. One block or 300 feet whichever is the shorter, shall be the maximum length of open trench ahead of pipe laying unless by written permission of the Engineer.

Except where tunneling or boring and jacking is specified and shown on the plan by the Engineer, all trench excavations shall be open cut.

10. Alignment and Grade. The alignment and grade or elevation of the pipeline shall be as shown on the plans.

The Contractor must maintain a constant check of the pipe alignment and trench depth and will be held responsible for any deviations there-from. Sewers twenty-four inches (24") (61 cm) or less shall be laid with straight alignment between manholes. Straight alignment shall be checked by either using a laser beam or lamping.

11. Limiting Trench Width. Trenches shall be excavated to a width which will provide adequate working space and pipe clearances for proper pipe installation, jointing, and embedment. Ledge rock, boulders, and large stones shall be removed to provide a clearance of six (6) inches below and on each side of all pipe. These distances are minimum clear distances which will be permitted between any part of the pipe and appurtenances being laid on any part, projection, or point of such rock, boulder, or stone.

Cutting trench banks on slopes to reduce earth load to prevent sliding and caving will be permitted only in areas where the increased trench width will not interfere with surface features or encroach on right-of-way limits. Slopes shall not extend lower than one (1) foot above the top of the pipe.

Limiting trench widths below an elevation of one (1) foot above the exterior top of the installed pipe shall be not less than fifteen (15) inches nor more than twenty-four (24) inches greater than the nominal outside diameter of the pipe.

12. Unauthorized Trench Widths. When, for any reason, the width of the lower portion of the trench as excavated at any point exceeds the maximum permitted in the foregoing, either pipe of adequate strength, special pipe embedment, or arch concrete encasement, as required by loading conditions and as determined by the Engineer, shall be furnished and installed by and at the Contractor's expense.
13. Trench Bottom in Earth. The trench in earth shall have a flat bottom the full width of the trench and shall be excavated to grade 4-inches below bottom of the pipe to be laid. Granular pipe embedment material shall be used to restore the trench bottom to the desired elevation and grade and to provide a uniform bearing and continuous support for the pipe along its entire length
14. Rock Exploration. Unless shown otherwise on the plans or noted in the Special Provisions, no rock exploration has been made. On those projects where rock exploration has been made, test holes have been drilled at locations and intervals as shown on the plans or subsurface information report to determine the approximate location and depth of rock. Resistance to penetration was assumed to be "solid rock". This information is furnished for general reference purposes only.
15. Trench Bottoms in Rock. All rock excavation shall be carried to a minimum of 6 inches below the bottom of the pipe. Granular pipe embedment material shall be used to restore the trench bottom to the desired elevation and grade and to provide a uniform bearing and continuous support for the pipe along its entire length. Care shall be exercised to prevent any portion of the pipe from coming to bear on solid rock or boulders.
16. Mechanical Excavation. The use of mechanical equipment will not be permitted in locations where its operations would cause damage to trees, buildings, culverts, or other existing property, utilities, or structures above or below ground. In all such locations, hand-excavating methods shall be used.

Mechanical equipment used for trench excavation shall be of the type, design and construction and shall be so operated that the rough trench excavation bottom elevation can be controlled, that uniform trench widths and vertical sidewalls are obtained at least from the bottom of the trench, and that trench alignment will be centered in the trench with adequate clearance between the pipe and sidewalls of the trench. Undercutting the trench sidewall to obtain clearance will not be permitted.

All mechanical trenching equipment, its operating conditions, and the manner of its operations shall be subject at all times to the approval of the Engineer.

17. Stream Crossings. Stream crossings shall be made in accordance with these specifications and as shown on the plans.

The trench width shall be as required for proper pipe installation and the

trench depth shall be as required to give minimum cover shown on the plans, Pipe encasement, where required, shall be in accordance with the specifications and placed as indicated on the plans.

18. Highway and Railroad Crossings. The Contractor shall make highway and railroad crossing in accordance with these specifications, the Special Provisions and as shown on the plans.

All construction or work performed and all operations of the Contractor, his employees, or his subcontractors within the limits of highway or railroad right-of-ways shall be in conformity with all the requirements, regulations and be under the control of the authority owning or having jurisdiction over and control of the right-of-way. All notifications of the owning authority shall be through the Engineer

The Contractor shall pay fees and obtain permits to make the crossings unless otherwise directed.

3014 HANDLING:

Handle pipe materials and fittings in a manner to insure installation in sound and undamaged condition. Do not drop or bump. Use slings, lifting lugs, hooks and other devices designed to protect pipe, joint elements and coatings. In handling plastic pipe of ten (10) feet in length or greater, a double sling will be required unless otherwise approved by the Engineer.

Materials shall be shipped, moved and stored with provisions to prevent movement or shock contact with adjacent units.

3015 INSTALLATION:

- A. All work shall be in accordance with the following standards:

Flexible Thermoplastic Pipe; ASTM C600
Ductile Iron Water Mains; AWWA C600

- B. Utilize equipment, methods and materials insuring installation to lines and grades indicated.

1. Maintain the following tolerances from true alignment and grade between manholes:

Alignment	3 inches
Grade	+/- 1 inch

Joint deflection shall not exceed the maximum allowable deflection per joint according to ASTM C 425, ASTM C 594 and AWWA C 600. Only one correction for alignment and/or grade shall be made between adjacent manholes.

2. Except where pipe sections are being encased in concrete, no pipe is to be supported by blocks.

- C. Install pipe of size, material, strength class, and joint type with embedment as shown on the Plans.
- D. Insofar as possible, commence laying at downstream end of line and install pipe with spigot or tongue end downstream.
- E. Clean interior of all pipe, fittings, and joints prior to installation. Exclude entrance of foreign matter during discontinuance of installation. Close open ends of pipe with snug fitting closures. Do not let water fill trench. Include provisions to prevent flotation should water control measures prove inadequate. Remove water, sand, mud and other undesirable materials from trench before removal of end cap.
- F. Install pipe only when weather and trench conditions are suitable. Do not lay pipe in water. Brace or anchor pipe as required preventing displacement after establishing final position.
- G. Ledge rock, boulders, and large stones shall be removed to provide a minimum clearance of four inches (4") (10 cm) below and on each side of all pipe(s).

3016 PIPE BEDDING:

The sewer trench shall be carried to a point not less than two (2) inches below bottom of pipe bell, or less than four (4) inches below bottom of pipe barrel, whichever is greater. Crushed stone pipe bedding, compacted to full width of trench, shall then be placed and compacted to bottom of pipe with proper allowance for bell joints or couplings. After each length of pipe being laid has been shoved "home" and placed in proper alignment, it shall be securely anchored and held in position by crushed stone backfill extending to a point not less than six (6) inches above the top of the pipe bell or coupling. If unstable subgrade conditions are encountered and it is determined by the Engineer that the bedding specified will not provide suitable support for the pipe, additional excavation to the limits determined by the Engineer will be required. This additional excavation shall be backfilled with crushed stone material approved by the Engineer.

Rigid pipe. Bedding Classes A, B, C, or crushed stone, as described in ASTM C12, shall be used and carefully compacted for all rigid pipe provided the proper strength pipe is used with the specified bedding to support the anticipated load based on the type of soil encountered and potential groundwater conditions.

Composite pipe. Except as described in ASTM D2680, the bedding, haunching, and initial backfill requirements for composite pipe shall be the same as for plastic pipe.

3017 JOINTING:

A. General Requirements.

1. Locate joints to provide for differential movement at changes in type of pipe embedment, concrete collars, and structures. Support pipe from wall of manhole at first joint in normal sewer trench with concrete cradle structurally continuous with base slab or footing.
2. Clean and lubricate all joint and gasket surfaces with lubricant recommended by pipe manufacturer.
3. Utilize methods and equipment capable of fully homing or making up joints

without damage.

4. Check joint opening and deflection for specification limits.
5. Examine each piece of pipe prior to installation for soundness and specification compliance.

B. Provisions for Jointing Ductile Iron Pipe.

1. Conform with AWWA C 600.
2. Paint suspected damaged portions with turpentine and dust with cement to check for cracks. Remove turpentine and cement by washing when crack test is satisfactorily completed. If cracks are found, the pipe shall be rejected.
3. Check gasket position and condition after assembly prior to installation of next pipe section.

C. Provisions for Jointing PVC Pipe. Check gasket for position and condition after assembly prior to installation of next pipe section.

D. Provisions for Jointing HDPE Pipe. Connection shall be made in conformance with manufacturer's recommendations.

3018 CUTTING:

Cut in neat workmanlike manner without damage to pipe. Observe specification regarding joint locations. Smooth cut by power grinding to remove burrs and sharp edges. Repair lining as required and approved.

3019 TEMPORARY PLUGS:

- A. Plugs. Provide and install plugs as manufactured by pipe supplier or as fabricated by Contractor if approved. Plugs shall be water-tight against heads up to 20 feet of water. Secure plugs in place in a manner to facilitate removal when required to connect pipe.
- B. Location. Plugs shall be installed as specified or where shown on 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.

3020 CONNECTIONS TO EXISTING PIPELINES AND STRUCTURES:

- A. Connect pipe to existing structures and pipelines where indicated. Observe pertinent articles of specifications pertaining to joint locations.
- B. Openings in manhole sections for sewer connections shall be core-drilled and shall be done to produce a smooth, uniform, cylindrical hole of proper size to accommodate a resilient connector meeting requirements of ASTM C 923. The resilient connectors shall be either Fernco or PSX Gasket or approved equals. Any additional holes cut in the field shall be drilled with a core-drill or in a manner approved by the Engineer.

- C. Manholes to be built on an existing sewer shall be constructed in such a manner as will not disrupt service of the existing sewer. The manhole base, walls and invert shall be completed before the top half of the sewer pipe is cut or broken away. Rough edges of the pipe thus exposed shall be covered with expansive grout, in such a manner as to produce a smooth and acceptable finish. Any portion of the existing sewer damaged by the Contractor shall be repaired or replaced at no expense to the City.
- D. Connections between pipes shall be made using a proprietary transition coupling or stainless steel Fernco gasket or approved equal, unless otherwise specified on the Plans.

Service connections. Service connections to the sewer main shall be watertight and not protrude into the sewer. If a saddle type connection is used, it shall be a device designed to join with the types of pipe which are to be connected. All materials used to make service connections shall be compatible with each other and with the pipe materials to be joined and shall be corrosion proof.

3021 TRENCH BACKFILL:

- A. Traditional Backfill. Compacted backfill shall be required for the full depth of the trench above the embedment where beneath structures, street, road, or highway right-of-way, driveways, walks, parking areas, and at all locations shown on the plans or as directed by the Engineer during the progress of the work.

Final backfill shall be of a suitable material removed from excavation except where other material is specified. Debris, frozen material, large clods, stones, organic matter, or other unstable materials shall not be used for final backfill within two feet (2') (0.6 m) of the top of the pipe.

The top portion of the backfill beneath established sod areas shall be finished with at least twelve (12) inches of topsoil corresponding to, or better than, that underlying adjoining sodded areas. Topsoil shall be approved by the Engineer prior to placement, and unless otherwise directed, shall be material previously excavated and stockpiled for the purpose during excavating and grading operations. Grades on areas to receive topsoil shall be established and maintained as a part of the grading operations. Immediately prior to dumping and spreading topsoil, the surface shall be loosened by disking or scarifying to a depth of two (2) inches to permit bonding of the topsoil to the underlying surface.

At the option of the Contractor, compacted backfill may be job-excavated material or material obtained off site, except that all street crossings shall be backfilled with MoDOT Type I rock, four (4) feet back of curb to four (4) feet back of curb, unless authorized by the City Engineer. Job-excavated material may be used for compacted backfill (outside of Street Right of Ways) when the job-excavated material is finely divided and free from debris, organic material, cinders, or other corrosive material, and stones larger than three (3) inches in greatest dimension. Large masses of moist, stiff clay shall not be used. Job-excavated material shall be compacted to ninety-five (95) percent of maximum density at optimum moisture content as determined by ASTM D698 when the test is appropriate, or to seventy (70) percent relative density as determined by ASTM D2049 when that test is appropriate.

The method of compaction and the equipment used shall be appropriate for the material to be compacted and shall not transmit damaging shocks to the pipe.

The combination of the thickness of the layer, the method of compaction and the type of compaction equipment used shall be at the discretion of the Contractor subject to obtaining the densities as specified above.

Backfill shall not be placed when material contains frost, is frozen, or a blanket or snow prevents proper compaction. Backfill shall not contain waste material, organic material, or debris of any kind.

Trench backfill above pipe embedment in locations other than those specified shall be compacted to ninety (90) percent of maximum density at optimum moisture content as determined by ASTM D698, unless otherwise permitted by the Engineer.

Uncompacted earth backfill material to be placed above embedment's shall be free of brush, roots, rocks more than two (2) inches in diameter, debris, cinders, or other corrosive material, and junk, but may contain rubble and debris from rock excavation, stones, and boulders in certain portions of the trench depth. Uncompacted backfill material above embedment's may be placed by any method acceptable to the Engineer which will not impose excessive concentrated or unbalanced loads, shock, or impact on and which will not result in displacement of installed pipe. Uncompacted backfill shall be placed to the extent necessary to prevent excessive future settlement.

Compact masses of stiff clay or other consolidated material more than one (1) cubic foot in volume shall not be permitted to fall more than five (5) feet into the trench unless cushioned by at least two (2) feet of loose backfill above pipe embedment.

No un-compacted trench backfill material containing rocks, or rock excavation detritus, shall be placed in the upper eighteen (18) inches of the trench except with specific permission of the Engineer, nor shall any stone larger than eight (8) inches in its greatest dimension be placed within three (3) feet of the top of pipe. Large stones may be placed in the remainder of the trench backfill only if well separated and so arranged that no interference with backfill settlement will result.

All excess bedding rock and other excavation debris shall be removed from surface before final grading can be accepted for seeding or sodding.

- B. Flowable Fill is an acceptable Backfill material. Refer to Specification 2000 for Flowable Fill requirements.

3022 STRUCTURE BACKFILL:

Backfill around structures shall be compacted to the extent necessary to prevent future settlement by tamping or other means acceptable to the Engineer.

Material for backfill shall be composed of earth only and shall contain no wood, grass, roots, broken concrete, stones, trash, or debris of any kind. No tamped or otherwise mechanically-compacted backfill shall be deposited or compacted in water.

No backfill shall be placed over or around any structure until the concrete or mortar therein has

attained a minimum strength of 2000 psi and can sufficiently support the loads imposed by the backfill without damage.

The Contractor shall use utmost care to avoid any wedging action between the side of the excavation and structure that would cause any movement of the structure. Any damage caused by premature backfill or by the use of equipment on or near a structure will be the responsibility of the Contractor.

Backfill shall be placed and compacted on all sides of the structure simultaneously, and operations shall be so conducted that the backfill is approximately the same elevation on all sides of the structure.

No excavated rock larger than four (4) inches maximum dimension shall be placed within one (1) foot of the exterior surface of any structure.

3023 DENSITY TESTING:

At the option of the Engineer, in-place field density testing to determine compliance with specified compaction requirements may be performed using a nuclear moisture-density measuring device. Such testing shall be performed in trenches with no more than one (1) foot lifts. The field testing results shall be immediately available to the inspector. If, as a result of this field testing, the engineer determines that further compaction is required, the Contractor shall revise his compaction procedures to obtain the results specified.

3024 DRAINAGE MAINTENANCE:

Trenches across roadways, driveways, walks, or other trafficways adjacent to drainage ditches or water courses shall not be backfilled prior to completion of backfilling the trench on the upstream side of the trafficway, to prevent impounding water after the pipe has been laid. Bridges and other temporary structures required to maintain traffic across such unfilled trenches shall be constructed and maintained by the Contractor. Backfilling shall be done so that water will not accumulate in unfilled or partially-filled trenches. All material deposited in roadway ditches or other water courses crossed by the line of trench shall be removed immediately after backfilling is completed and the original section, grades, and contours of ditches or water courses shall be restored. Surface drainage shall not be obstructed longer than necessary.

3025 PROTECTION OF TRENCH BACKFILL IN DRAINAGE COURSES:

Where trenches are constructed in ditches or other water courses, backfill shall be protected from surface erosion. When the grade of the ditch exceeds one (1) percent, ditch checks shall be installed. Unless otherwise shown on the drawings or directed by the Engineer, ditch checks shall be concrete. Ditch checks shall extend not less than two (2) feet below the original ditch or water course bottom for the full bottom width and at least eighteen (18) inches into the side slopes and shall be at least twelve (12) inches thick.

3026 DISPOSAL OF EXCESS EXCAVATED MATERIALS:

Except as otherwise permitted, all excess excavated materials shall be disposed of away from the site or work.

Broken concrete and other debris resulting from pavement or sidewalk removal, excavated rock in excess of the amount permitted to be and actually installed in trench backfill, junk, and debris encountered in excavation work and other similar waste materials shall be disposed of away from the site of the work.

Excess earth from excavation located in unimproved property shall be distributed directly over the pipe trench and within the pipeline right-of-way to a maximum depth of six (6) inches above the original ground surface elevation at and across the trench and sloping uniformly. Drag with blade machine or other suitable tool to a smooth, uniform surface without obstructing drainage at any point. Wasting of excess excavated material in the above manner will not be permitted where the line of trench crosses or is within a railroad, public road, or highway right-of-way. The disposal of waste and excess excavated materials, including hauling, handling, grading, and surfacing shall be a subsidiary obligation of the contractor.

3027 SETTLEMENT:

The Engineer may perform periodic inspections to insure that no settlement has occurred. The Contractor shall be responsible for all settlement of backfill, fills and embankments which may occur within two (2) years of time after final acceptance of the contract under which the work was performed.

The Contractor shall make, or cause to be made, all repairs or replacements made necessary by settlement within thirty (30) days after notice from the Engineer. Should the Contractor fail to make such repairs the City Engineer may cause repairs to be made and the cost of these repairs shall be the responsibility of the Contractor. Within sixty (60) days of the expiration of the Warranty period, an inspection will be held by the Owner. The Contractor is invited to attend the Inspection

3028 PROTECTION OF DRINKING WATER SUPPLIES:

A. Cross Connections Prohibited. There shall be no physical connections between a public or private potable water supply system and a sewer, or appurtenance thereto which would permit the passage of any wastewater or polluted water into the potable supply. No water pipe shall pass through or come in contact with any part of a sewer manhole.

B. Relation to Water Works Structures.

1. While no general statement can be made to cover all conditions, it is recognized that sewers shall meet the requirements of 10 CSR 23-3.010, Rules of the Missouri Department of Natural Resources, with respect to minimum distances from public water supply wells or other water supply sources and structures.
2. All existing water works units, such as basins, wells, or other treatment units, within two hundred feet (200') (60 m) of the proposed sewer shall be shown on the engineering plans.

C. Relation to Water Mains.

1. Horizontal and vertical separation.

- A. Sewer mains shall be laid at least ten feet (10') (3.0 m) horizontally from any existing or proposed water main. The distances shall be measured edge-to-edge. In cases where it is not practical to maintain a ten-foot (10') (3.0 m) separation, the department may allow deviation on a case-by-case basis, if supported by data from the design engineer. Such a deviation may allow installation of the sewer closer to a water main, provided that the water main is in a separate trench or on an

undisturbed earth shelf located on one (1) side of the sewer and at an elevation so the bottom of the water main is at least eighteen inches (18") (46 cm) above the top of the sewer.

- B. If it is impossible to obtain proper horizontal and vertical separation as described above for sewers, the sewer must be constructed of slip-on or mechanical joint pipe or continuously encased and be pressure tested to one hundred fifty pounds per square inch (150 psi) (1,034 kPa) to assure watertightness.
- C. Manholes should be located at least ten feet (10') (3.0 m) horizontally from any existing or proposed water main.

2. Crossings.

A. Sewers crossing water mains shall be laid to provide a minimum vertical distance of eighteen inches (18") (46 cm) between the outside of the water main and the outside of the sewer. This shall be the case where the water main is either above or below the sewer. The crossing shall be arranged so that the sewer joints will be equidistant and as far as possible from the water main joints. Where a water main crosses under a sewer, adequate structural support shall be provided for the sewer to maintain line and grade.

- B. When it is impossible to obtain proper vertical separation as stipulated above, one (1) of the following methods must be specified:
 - (I) The sewer shall be designed and constructed equal to water pipe and shall be pressure tested to assure watertightness prior to backfilling; or
 - (II) Either the water main or sewer line may be continuously encased or enclosed in a watertight carrier pipe which extends ten feet (10') (3.0 m) on both sides of the crossing, measured perpendicular to the water main. The carrier pipe shall be of materials approved by the department for use in water main construction.

3029 LOCATION TRACER WIRE SYSTEM AND DETECTION MARKING TAPE:

Tracer wire shall be installed on all service lines between the mainline and two-way cleanout within the public right-of-way per Section 9100 Tracer Wire Pipe Detection System.

3030 CLEANOUTS:

A two-way cleanout shall be installed on proposed service lines near the edge of the right-of-way. The service line shall be stubbed approximately 5 feet beyond the cleanout from the main. The riser pipe and threaded cleanout adapter fitting shall match service line pipe size and material. Cleanout cover and frame shall be Neenah R-1976, or approved equal, color coded green, and shall rest on a 4" thick concrete support pad, top of pad being 8" from the surface grade. Tracer wire shall be terminated within the cleanout frame per detail D30-6.