

CITY OF BONNER SPRINGS, KANSAS

**DIVISION II
CONSTRUCTION AND MATERIAL SPECIFICATIONS**

SECTION 2500 SANITARY SEWERS

APPROVED AND ADOPTED THIS 11th DAY OF JULY, 2005
Revised January 28, 2013

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CITY OF BONNER SPRINGS, KANSAS

SECTION 2500 SANITARY SEWER

SECTION 2501 SCOPE:

This Division governs all work, materials and testing required for installation of gravity and pressure pipelines of the respective types and sizes shown on the Plans for the particular location and conforming to the requirements of these specifications. All pipelines shall be constructed to proper line and grade as shown on the Plans and shall result in an unobstructed, smooth and uniform conduit.

SECTION 2502 GENERAL:

2502.1 Description: Sanitary sewer construction shall consist of furnishing all labor, materials and equipment for the complete installation of sewers and appurtenances in accordance with the contract documents, standard drawings, approved shop drawings, General Provisions and these specifications.

2502.2 Revisions of Standards: When reference is made to a Standard Specification i.e. ASTM, ANSI, AWWA, MCIB, 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.

SECTION 2503 MATERIALS:

2503.1 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 for in the Special Provisions.

- A. Requirements:** Furnish pipe of materials, joint types, sizes, and strength classifications indicated or specified. Higher strengths may be furnished at the Contractor's option at no additional cost to the City.
- B. Manufacturer:** The manufacturer shall be experienced in the design, manufacture and commercial supplying of the specific material.
- C. Inspection and Testing:** Inspection and testing shall be performed by the Manufacturer's quality control personnel in conformance with applicable standards. Testing may be witnessed by City, Engineer, or approved independent testing laboratory. The Contractor shall provide three (3) copies of certified test reports indicating that the materials conform to the specifications.
- D. Handling:** Equipment and methods shall be adequate to protect the 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.

2503.2 Pipe, Fittings, Joints, Coatings and Linings:

A. General: Furnish pipe and fittings of materials, types, sizes, strength classes, coatings and linings as indicated and specified.

B. Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Composite Sewer Pipe and Fittings: Pipe and fittings shall conform to ASTM D 2680, except as otherwise specified herein.

1. General: Furnish maximum pipe lengths, normally produced by the manufacturer except for fittings, closures and specials. All field cuts that result in an exposed end section shall be sealed in accordance with the manufacturers' recommendation.
2. Design: Pipe shall consist of two concentric thermoplastic tubes integrally braced across the annulus with resultant annular space filled with inert material to provide continuous support between inner and outer tubes. Bell-end shall be factory attached solvent weld coupling. Minimum pipe stiffness shall be 200 psi.
3. Joints: Pipe joints and fittings shall be solvent cement or elastomeric type conforming to ASTM D 2680. Natural rubber gaskets will not be accepted.
4. Fittings: Fittings defined as tee (T) or wye (Y) connections suitable for assembly to four (4) inch or six (6) inch building service lines shall be bell end with a minimum wall thickness conforming to SDR 35 and shall be provided by the pipe manufacturer. A special design is required for service connections eight (8) inch and larger. Saddle tees or wyes will not be permitted during sewer main installation.

C. Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings: Pipe and fittings shall conform to ASTM D 2751, except as otherwise specified here-in.

1. General: Furnish maximum pipe lengths, normally produced by the manufacturer, except for fittings, closures and specials. Pipe use shall be limited to service lines.
2. Design: Pipe shall have an integral wall bell and spigot joint and a minimum wall thickness conforming to SDR 23.5 and a minimum pipe stiffness of 150 psi.
3. Joints: Pipe joints and fittings shall be solvent-cement or elastomeric conforming to ASTM D 2680. Gaskets for elastomeric joints shall conform to ASTM F477. Joint tightness shall also conform to ASTM D 3212. Natural rubber gaskets will not be accepted.
4. Fittings: Fittings defined suitable for assembly to four (4) inch or six (6) inch building service lines shall be bell-end with a minimum wall thickness conforming to SDR 23.5 and shall be provided by the pipe manufacturer.

D. Ductile-Iron Pipe and Fittings: Pipe and fittings shall conform to ANSI A21.5 1, except as otherwise specified herein.

1. General: Furnish maximum pipe lengths normally produced by the manufacturer except for fittings, closures and specials.
2. Design: All ductile iron pipe shall meet the requirements of ANSI A21.50 and ANSI A21.51, ASTM A536, Grade 60-42-10, Thickness Class 50, unless otherwise required by

the City Engineer.

3. Joints: Mechanical and push-on joints for pipe and fittings shall conform to the requirements of ANSI A21.1 1. Flanged joints for ductile iron pipe and fittings shall conform to the requirements of A21.10. Gaskets shall be neoprene or other synthetic rubber material. Natural rubber gaskets will not be acceptable.
4. Fittings: Fittings shall be in accordance with ANSI/AWWA C 110 and shall have a pressure rating of not less than that specified for the 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 have either mechanical joints or push-on joints.
5. Exterior Coating: Pipe and fittings shall be furnished with exterior bituminous coating conforming to ANSI A 21.51. Thickness of exterior bituminous coating shall be a minimum of one mil.
6. Interior Lining: All lining application must be performed by the pipe manufacturer at the pipe manufacturer's facility. Linings applied by individuals other than the pipe manufacturer are unacceptable and shall be rejected. Surface preparations and application of the liner product shall be per liner manufacturer's recommendations. The pipe or fitting manufacturer shall submit a certificate attesting their application of the product met the requirements of the liner manufacturer's specifications and that the material used was as specified. Liners for pipe and fittings shall conform to one of the following types:
 - a. Polyethylene With Fusion Bonded Epoxy: The lining shall be a composite lining utilizing a primer coating containing fusion-bonded epoxy (FBE) and a surface coating containing fusion-bonded polyethylene (FBP). The lining shall be PolybondPlus, manufactured by the American Cast Iron Pipe Company or approved equal. The primer shall contain fusion-bonded epoxy (FBE) which is applied in sufficient quantity to achieve a nominal thickness of 5 mils for the pipe or fitting. The surface layer shall be comprised of medium-density modified fusion-bonded polyethylene (FBP) meeting the requirements of ANSI/ASTM D1258 and compounded with an inert filler. The FBP shall be formulated to be ultra-violet (UV) resistant for a minimum of 3 years exposure. The color of the FBP shall have a light reflectance value (LRV) of at least 40% to aid in the in-situ inspection of the pipeline with video equipment. Total thickness for the fusion-bonded epoxy/fusion-bonded polyethylene lining shall be 60 mils nominal with a 50 mil minimum in the barrel of the pipe.

The joint surface coating shall cover the spigot end across the end of the spigot bevel and extending over the outer surface of the spigot including the gasket sealing area. The joint surface coating shall also cover the socket from the face of the bell, through the gasket sealing area overlapping onto the edge of the FBE/FBP lining.
 - b. Calcium Aluminate: The lining shall be SewperCoat as manufactured by Lafarge Calcium Aluminates or approved equal. Liner shall be a mortar made of fused calcium aluminate cement and fused calcium aluminate aggregates. A seal coat shall be applied to the lining.

Before lining, the inside of the socket, including a portion of the gasket cavity and a portion of the pipe barrel, shall be coated with a minimum of 8 mils of epoxy. The thickness of the lining shall be a minimum of:

- 0.125" for 6" through 12" (125 mils)
- 0.1875" for 14" through 24" (187 mils)
- 0.2500" for 30" through 48" (250 mils)

The lining thickness may taper to less than the specified minimum at the ends of the pipe. Field-cut end repairs are to be done in accordance with the manufacturer's recommendations.

Cracks, other than closed hairline cracks and/or fine crazing, shall not be acceptable. Loose areas of cement lining are not available. Visual inspection of the lining is sufficient.

- c. Ceramic Epoxy: The lining shall be Protecto 401 Ceramic Epoxy, or approved equal. The material shall be an amine cured novalec epoxy containing at least 20% of volume of ceramic quartz pigment. After the surface preparation and within 8 hours of surface preparation, the interior of the pipe shall receive 40 mils nominal dry film thickness. No lining shall take place when the substrate or ambient temperature is below 40° Fahrenheit. The gasket area and spigot end up to 6 inches back from the end of the spigot end must be coated with 6 mils nominal, 10 mils maximum Protecto Joint Compound, or approved equal. Coating of the gasket seat and spigot ends shall be done after the application of the lining.
7. Polyethylene Encasement: Pipe and fittings shall be installed with a polyethylene tube encasement having a minimum thickness of 0.008" (8 mils) and conforming to ANSI/AWWA C105/A21.5. All openings shall be taped and sealed.

E. Polyvinyl chloride (PVC) Pressure Rated Plastic Pipe (SDR) and Fittings: Pipe and fittings shall conform to ASTM D 2241, except as otherwise specified herein.

- 1. General: Furnish maximum pipe lengths normally produced by the manufacturer, except for fittings, closures and specials. Pipe shall be used only for pressure flow systems.
- 2. Materials: The pipe shall be made of PVC plastic pipe having a cell classification of 12454 B or 12454 C as defined in ASTM D 1784.
- 3. Design: Pressure flow systems, i.e., force mains, shall have the wall thickness shown on the plans, with a minimum wall thickness not less than SDR 32.5 with a minimum burst pressure not less than 400 psi (quick burst in accordance with ASTM D1599) conforming to pipe materials designation codes PVC 1120, PVC 1220, or PVC 2120.
- 4. Joints: Pressure flow systems shall be joined with flexible elastomeric seals in accordance with ASTM D 3139 with particular attention given to Section 5.3.
- 5. Fittings: Fittings for pressure flow systems shall have a minimum wall thickness conforming to SDR 32.5 with a minimum burst pressure not less than 400 psi (quick burst in accordance with ASTM D1599) conforming to pipe materials designation codes PVC 1120, PVC 1220, and PVC 2120.

F. Type PSM polyvinyl chloride (PVC) Sewer Pipe and Fittings: 8 through 15 inch diameter pipe and fittings shall conform to ASTM D 3034, and pipe having diameters of 18 through 27 inches shall conform to ASTM F679 except as otherwise specified herein.

1. General: Furnish maximum pipe lengths normally produced by the manufacturer except for fittings, closures and specials.
2. Materials: The pipe shall be made of PVC plastic having a cell classification of 12454 B, 12454 C or 13364 B, as defined in ASTM D 1784.
3. Design: Pipe shall have an integral bell and spigot joint. Wall thickness shall be SDR 35, SDR 26, SDR 23.5 or SDR 21 as shown on plans. All service lines shall be SDR 23.5. If for any reason the depth of cover on SDR 35 pipe becomes greater than 15 feet, the contractor shall immediately notify the design engineer.
4. Joints: Joint tightness shall conform to ASTM D 3212. Joints shall be push-on type only with the bell-end grooved to receive a gasket. Elastomeric seal (gasket) shall have a basic polymer of synthetic rubber conforming to ASTM F 477. Natural rubber gaskets will not be accepted.
5. Fittings: Fittings defined as tee (T) or wye (Y) connections suitable for assembly to four (4) inch or six (6) inch building service lines shall be bell end, with a minimum wall thickness conforming to SDR 23.5 and shall be furnished by the pipe manufacturer. A special design is required for service connections eight (8) inches and larger. Saddle tees or wyes will not be permitted during sewer main installation.

G. Reinforced Concrete Pipe and Fittings: Pipe and fittings shall conform to ASTM C 76 except as otherwise specified herein.

1. General: Furnish maximum lengths normally produced by the manufacturer except for fittings, closures and specials.
2. Design: Cement shall conform to ASTM C150, and shall contain not more than five (5) percent tricalcium aluminate. Pipe shall be Class III, Class IV, or Class V, wall B as shown on plans. Fine aggregate shall be natural sand conforming to the requirements of ASTM C33 and MCIB Section 4 - Materials. Reinforcement may be circular or elliptical. Elliptically reinforced pipe shall be marked in accordance with Section 17.2, ASTM C 76 for correct installation. Modified or special designs are prohibited unless so specified in the Special Provisions.
3. Joints: Pipe and fittings shall be furnished with steel end joints with spigot groove and O-ring gaskets conforming to ASTM C 361 and ASTM C 443. The basic polymer for O-ring gaskets shall be synthetic rubber and shall conform to ASTM C 361 and ASTM C 443.
4. Fittings and Specials: Provide strength equal to design D-loads of adjacent pipe and be fabricated as one of the following types:
 - a. Steel cylinder segments not less than U.S. No. 16 gauge lined with three-fourths (3/4) inch concrete or mortar and reinforced concrete exterior.

- b. Concrete pipe sections shall be cut while still green, reinforcing exposed and welded together at junctions and miters. Splice shall be built up to nominal wall thickness with mortar or concrete. Miters shall not exceed 30 degrees at deflection angles between segments. Minimum center line curve radius shall not be less than twice the pipe diameter.

H. Vitrified Clay Pipe and Fittings: The use of vitrified clay pipe and fittings is not permitted.

I. High-Density Poly Ethylene (HDPE) Pipe and Fittings: Materials used for the manufacture of polyethylene pipe and fittings shall be PE 3408 high density polyethylene meeting cell classification 345464C for black or 345464E for color and stripes per ASTM D 3350; and shall be listed in the name of the pipe and fitting Manufacturer in PPI (Plastics Pipe Institute) TR-4 with a standard grade HDB rating of 1600 psi at 73°F. The Manufacturer shall certify that the materials used to manufacture pipe and fittings meet these requirements. The fitting material may be gray or black. Polyethylene pipe and fittings shall be supplied by the same qualified and approved manufacturer.

1. Polyethylene Pipe: Pipe shall be manufactured in accordance with ASTM F 714 and shall be so marked. Each production lot of material or pipe shall be tested for melt index, density and for black pipe, % carbon. Each production lot of pipe shall be tested for dimensions and ring tensile strength.
2. Polyethylene Fittings: Polyethylene fittings shall be molded or fabricated by the approved pipe manufacturer. Butt fusion outlets shall be made to the same outside diameter, wall thickness, and tolerances as the mating pipe. Molded polyethylene fittings shall be manufactured in accordance with ASTM D 3261 and shall be so marked.
3. Polyethylene Flange Adapters: Flange adapters with manufacturer recommended back-up ring shall be made with sufficient through-bore length to be clamped in a butt fusion-joining machine without the use of a stub-end holder. The sealing surface of the flange adapter shall be machined with a series of small v-shaped grooves (serrations) to promote gasketless sealing, or restrain the gasket against blowout.
4. MJ Adapters: MJ Adapters shall have a stainless steel stiffener that is mechanically locked into the adapter.

2503.3 Pipe Embedment Materials

A. Scope: Pipe embedment materials shall be furnished and installed to complete the work shown on the Plans or as called for in the Contract Documents.

B. Bedding Aggregate: All materials used for crushed stone pipe bedding shall conform to the requirements of MCIB Section 4 - Materials for Coarse Aggregate - Table 2, Column III, modified to meet the following graduations:

Sieve Size Gradations	Percentage Passing
No. 4	0-5
No. 8	0-2

C. Concrete for embedment and encasement:

1. Concrete shall test not less than a twenty-eight (28) day compressive strength of 4000 psi. and shall otherwise conform to Section 2510.3.E.
2. Reinforcing steel when required shall be placed as shown on the Plans and shall conform to Section 2510.3.F.
3. All concrete shall cure for twenty-four (24) hours prior to backfill.

2503.4 Backfill Materials

- A. Scope:** Backfill materials shall be as required and/or permitted to complete the work shown on the Plans or called for in the Contract Documents.
- B. Granular Backfill Material:** Granular bedding shall be crushed rock with not less than 95 percent passing a one-half (1/2) inch screen and not less than 95 percent retained on a No.4 screen. Place in not more than six (6) inch layers, and compact by slicing with a shovel or vibrating.
- C. Select Earth Backfill Material:** Select earth backfill shall be finely divided job excavated material free from debris, organic matter, rocks larger than one (1) inch, wet materials, and frozen materials.
- D. Flowable Backfill, Controlled Low Strength Material (CLSM):** Flowable fill shall be composed of Portland cement, fly ash (optional), fine aggregate, coarse aggregate (optional), water, and a shrinkage compensator, proportioned as required to create a mix as approved by the Engineer. Design strength shall not exceed 100 psi.
- E. Other Earth Backfill:** Other backfill may be job excavated material free from debris and organic matter. No rock greater than three (3) inches in its longest axis, shall be placed in any trench excavation as backfill.

2503.5 Tunneling, Boring and Jacking Materials

- A. Scope:** This section governs the furnishing of all materials necessary for the construction of tunnels at locations shown on the Plans or where constructed at the Contractor's option when approved by the Engineer.
- B. General:** Furnish materials and necessary accessories with strengths, thicknesses, coatings, and fittings indicated, specified and/or necessary to complete the work.
- C. Steel Liner Plate:** Steel tunnel liner plates shall be Armco "Standard," Commercial Shearing and Stamping Company "Commercial," Republic "Truscon Paneled Out," or equal and shall be galvanized in accordance with ASTM A 123. The design and shape of the liner plates shall be such that assembly can take place entirely from within the tunnel liner. Liner plates shall be capable of withstanding the ring thrust load and transmitting this from plate to plate. The minimum outside diameter shall be four (4) feet and the minimum wall thickness shall be United States Standard Gauge 12 (0.2046 inches). Sufficient sections shall be provided with one and one-half (1 1/2) inch or larger grouting holes located near the centers so that when the plates are installed there will be one line of holes on either side of the tunnel and one at the crown; the lower line of holes on each side shall not be more than 18 inches above the

invert. The holes in each line shall not be more than five (5) feet apart and unless otherwise approved, shall be staggered. Bolts and nuts shall conform to ASTM A 153, A 307, A 325 and A 449 as applicable. Steel liner plates shall have bolted joints in both longitudinal joints in adjacent rings when assembling.

D. Steel Casings: Steel casings for bored or jacked construction shall be steel pipe conforming to ASTM A 139 with a minimum diameter as shown on the Plans. Corrugated steel casing pipe will be considered on a case-by-case basis.

1. Minimum wall thickness shall be in accordance with the following table:

Diameter of Casing-Inches	Nominal Wall Thickness-Inches	
	Under Railroads	All Other Uses
16	0.312	0.188
18	0.312	0.250
20	0.375	0.250
22	0.375	0.250
24	0.406	0.281
26	0.438	0.281
28	0.469	0.312
30	0.469	0.312
32	0.500	0.312
34	0.500	0.312
36	0.500	0.344

2. Steel shall be Grade B under railroads and Grade A on all other uses.

3. Steel pipe shall have welded joints in accordance with AWWA C 206.

E. Reinforced Concrete Pipe: Reinforced concrete pipe used as casing shall conform to ASTM C 76 except as otherwise specified under Section 2503.2.G, and as specified herein.

1. Design: Provide ASIM C 76 circular pipe of the strength class required for the jacking of pipe when determined by method set forth in the latest printing of Concrete Pipe Design Manual prepared by the American Concrete Pipe Association.

2. Joints: Reinforced concrete pipe used for casing pipe shall be provided with steel end joint with a groove in the spigot end for an O-ring gasket. The O-ring gasket shall be synthetic rubber. Both joint and gasket shall otherwise conform to ASTM C 361.

3. Interior Protection: Interior protection is not required for reinforced concrete pipe used for casing conduit.

F. Casing Conduit Grout: If required, casing conduit grout shall be a pumpable grout resulting in minimum set strength of 400 psi in 28 days.

G. Sand: Sand used as fill in casing conduits shall be a clean sand and thoroughly dry. All sand fill shall conform to the requirements under Section 2510.3.E.

H. Casing Spacers: Required.

2503.6 Location Wire and Tape:

- A. Location Wire:** Location wire shall be minimum 14 gauge, insulated with green polyethylene, be steel core with copper cladding, and marketed by the manufacturer for direct bury applications. Split bolt connectors, gel encapsulated splice kits (3M DBR-6 Direct Bury Splice Kits or approved equal) or approved equal service connectors shall be used at splice points to maintain electric continuity.
- B. Marking Tape:** Marking tape shall be constructed of chemically inert material, 4.0 mils thick minimum, 6 inches wide, and marked in chemically inert ink. Neither tape nor ink shall degrade when exposed to acids, alkalies and other destructive substances commonly found in soil. The marking tape shall be green in color and have "Sewer Line" printed on the tape at 20 to 30 inch intervals. Tape shall be a tape such as Tara Tape® marking tape from Reef Industries or engineer approved equal.

SECTION 2504 SITE PREPARATION

2504.1 Scope: This section governs normal project site preparation for construction.

2504.2 General

- A. Clearing:** Contractor shall do all clearing necessary for performance of his work and shall confine his operations to that area provided through easements, licenses, agreements and rights-of-way. The Contractor's entrance upon any lands outside of that area provided by easements, licenses, agreements or public rights-of-way, shall be at the Contractor's sole liability.
- B. Occupation:** The Contractor shall not occupy any portion of the Project Site prior to the date established in the Notice to Proceed without prior approval of the Engineer.

2504.3 Obstructions

- A. General:** Natural obstructions, existing facilities and improvements encountered during site preparation shall be removed, relocated, reconstructed or worked around as herein specified. Care shall be used while performing site preparation work adjacent to any facilities intended to remain in place. Except as otherwise specified, the Contractor shall be responsible for any damage to existing facilities and improvements and any repairs required shall be promptly made at the Contractor's expense. Waste materials shall be disposed of in a satisfactory manner off the work site. Restoration of utilities damaged by the Contractor shall be restored as directed by the utility company at no additional cost to the City. Unless otherwise provided in Basis of Payment no separate or additional payment will be made for any work in connection with removal, relocation or restoration of obstructions and existing facilities.
- B. Surface Obstructions:**
 - 1. Sidewalks, curb and gutter, drainage structures and similar obstructions shall be tunneled under if tunneling is best suited, otherwise the obstruction shall be cut in straight lines or removed to the nearest construction joint if located within five feet of the centerline of the trench. In no case shall the joint or line of cut be less than one foot outside the edge of the trench. Surface obstructions removed to permit construction shall be reconstructed as

specified and to the dimensions, lines and grades of original construction. Backfill of tunneled sections shall be performed in accordance with Section 2507. All restoration shall be in accordance with Section 2508.

2. Mailboxes shall be maintained in the manner that the Postal Service requires to prevent interruption of mail delivery.
3. Site preparation shall include, where necessary and permitted, the removal of trees, shrubs, brush, crops, and other vegetation within the limits of the easements (right-of-way) or as may be provided for in licenses, permits and agreements. The following procedures for protection of existing greenery are required.

- a. Trees: All reasonable effort shall be made to save as many trees as possible. Trees are defined as six (6) inches in diameter and greater when measured at a point three (3) feet above the ground surface. If trees can be saved by trimming, this shall be done in accordance with acceptable pruning practices.

All trees within easements or right-of-way provided, which are specifically to be removed or saved, have been marked on the plans with the following notations:

- i. Trees marked "S" shall be saved.
- ii. Trees marked "X" shall be removed.
- iii. Trees marked "R" shall be removed and replaced.

Trees to be removed shall be completely removed, including stump and large roots, unless such removal may result in damage to existing pipelines. In that event, trees shall be sawn off not more than four (4) inches above the ground and the stump shall be removed to 12 inches below finish grade. Any tree replaced shall be outside the permanent sewer right-of-way and shall be like species of nursery stock. (Generally two (2) to two and one-half (2 1/2) inch caliper).

- b. Small Plants and Flowers: At least two (2) weeks prior to the start of construction, property owners shall be notified by the contractor of the proposed starting date. The purpose of this notification is so that the property Owners can remove any small plants or flowers that they desire to save.
4. Fences: Fences interfering with construction, and located within public rights-of-way or as may be allowed for in permits or agreements, may be removed by the Contractor only if the opening is provided with a temporary gate that will be maintained in a closed position except to permit passage of equipment and vehicles unless otherwise herein specified. Fences within temporary construction easements may be removed by the Contractor provided that temporary fencing is installed in such a manner as to serve the purpose of the fencing removed. The contractor shall locate and record all fence corners prior to removal. All fencing removed shall be restored by the Contractor to the condition existing prior to construction unless otherwise specified in the Special Provisions. The Contractor is and shall be solely liable for the straying of any animals protected or corralled or other damage caused by any fence so removed.
 5. Property Pins: The Contractor shall preserve all property corners, pins or markers. In the event any property comers, pins, or markers are removed by the Contractor, such property points shall be replaced at the Contractor's expense and shall be reset by

competent surveyors properly licensed to do such work. In the event such points are section comers or Federal land comers, they shall be referenced and filed with the appropriate authority.

6. Sodded and Landscaped Areas: Sodded and/or landscaped thoroughfares and areas on or adjacent to improved property shall be disturbed only to the extent required to permit construction. Such areas shall not be used as storage sites for construction supplies and, insofar as practicable, shall be kept free from stockpiles or excavated materials.

C. Subsurface Obstruction:

1. Where existing utilities and service lines are to be encountered, the Owner thereof shall be notified by the Contractor at least 72 hours (not including weekends and/or holidays) in advance of performing any work in the vicinity. All excavation, pipeline installation and backfilling work in the vicinity of such utilities shall be accomplished in the manner required by the Owner and, if requested, under their direct supervision. The Contractor shall be responsible for any and all damages to any public or private utility that may occur as the result of the construction.
2. The Contractor shall make a reasonable effort to ascertain the existence of obstructions and shall locate obstructions by digging in advance of machine excavation where definite information is not available as to their exact location. Where such facilities are unexpectedly encountered and damaged, responsible officials and other affected parties shall be notified and arrangements made for the prompt repair and restoration of service.
3. Private Sewer Facilities: The Contractor shall make every reasonable effort to protect private sewer facilities. They are not shown on the Plans. When these facilities are disturbed or damaged by the work, the Contractor shall make necessary repairs to the facilities for continuous service prior to the close of the work day at no cost to the City.

SECTION 2505 EXCAVATION

2505.1 Scope: This section governs the methods and procedures required for pipeline excavations for open cut and tunneling.

2505.2 General: The terms "excavation" and "trenching" shall mean the removal and subsequent handling of all material required to perform the work.

- A. Excavation:** All pipeline excavation work shall be accomplished under supervision of a person experienced with the materials and procedures which will provide protection to existing improvements, including utilities and the proposed pipeline.
- B. Layout:** The alignment, depth, and pipe subgrades of all sewer trenches shall be maintained as shown on the contract drawings by overhead grade lines parallel to the sewer invert or with the use of an approved laser alignment device.
- C. Embankment:** When pipe is to be installed in embankment or fill, the embankment shall be constructed in accordance with Section 2102.2 and shall be built up to a plane at least 18 inches above the top of the pipe prior to the excavation of the sewer trench.

D. Trenching: The Contractor shall not open more trench in advance of pipe laying than is necessary. One block or 400 feet, whichever is the shorter, will be the maximum length of open trench allowed on any line under construction. All open trenches shall be adequately protected.

E. Hazardous Wastes: In the event hazardous wastes as defined by the Resource Conservation and Recovery Act of 1976 (PL94-580) are encountered, work shall be halted and the Engineer shall be notified. Work shall be resumed only after the Engineer notifies the Contractor. Regulation of removal, handling and disposal of hazardous wastes is the responsibility of Federal and State agencies.

2505.3 Unclassified Excavation: Unclassified excavation is defined as the removal of all material encountered regardless of its nature. All material excavated will be considered as Unclassified Excavation unless the Special Provisions specify Classified Materials.

2505.4 Classified Excavation: When specifically indicated in the proposal and contract, classification of excavated materials will be made as follows:

A. Rock Excavation: Rock excavation is defined as the removal of all rock ledges six (6) inches or more in thickness, detached rock or boulders having a volume of more than one and one-half (1 1/2) cubic yards and shale occurring in its natural state, hard and unweathered. A rock ledge is defined as a continuous body of rock that may include interbedded seams of soft materials. Such interbedded soft material less than 12 inches in thickness will be included in the measurement of rock excavation. Such seams 12 inches or greater in thickness will be included only in the measurement of earth excavation.

B. Earth Excavation: Earth excavation is defined as the removal of all material not defined as rock.

2505.5 De-Watering: 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 subgrade preparation and continually thereafter until 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 trenches which extend down to or below groundwater shall be dewatered by lowering and keeping the water level beneath such excavations 12 inches or more below the bottom of the excavation.

Surface water shall be diverted or otherwise prevented from entering excavated area or trenches to the greatest extent practicable without causing damage to adjacent property. Contractor shall be responsible for obtaining all applicable water discharge permits.

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

2505.6 Blasting: The contractor shall comply with all laws, ordinances, applicable safety code requirements, and regulations relative to the handling, storage, and use of explosives and the protection of life and property. The Contractor shall be responsible for all damage caused by his blasting operations and shall be responsible for responding to all complaints. Suitable methods shall be employed to confine all materials lifted by blasting within the limits of the

trench excavation.

The Contractor shall not blast any rock or other materials, or allow the same to be done in prosecution of the work unless they secure proper insurance coverages and a blasting permit from the City of Bonner Springs.

Suitable methods shall be employed to confine all materials lifted by blasting within the limits of the excavation or trench. All rock which cannot be handled and compacted as earth shall be kept separate from other excavated materials and shall not be mixed with backfill or embankment materials, except as specified or directed by the Engineer. All unusable or excess rock materials shall be removed from the site and disposed of in an approved location.

When required by the Engineer, the Contractor shall provide a preblast survey of all structures located within 1,000 feet of his blast sites. The survey shall be of such nature as to accurately establish the structural condition of all houses, buildings, bridges, overpasses, etc., within the specified area. No blasting shall be allowed until the preblast survey has been completed and has been reviewed and accepted by the Engineer. The Contractor must submit to the Engineer preblast survey reports for all structures within the specified area. The preblast survey shall be performed by qualified personnel regularly engaged in blast operations.

Before blasting is started, the Contractor shall inform all residents within a radius of 1,000 feet of the blasting location by means of printed information sheets, news releases or other acceptable methods.

The Contractor shall provide suitable warning by siren or whistle prior to all blasts.

When blasting is to occur within 500 feet of any structure adjacent to the blast site, the Contractor shall obtain ground vibration monitoring and interpretation for each blast by qualified personnel regularly engaged in blast operation monitoring and control. One (1) copy of the recorded data from each blast, including the computed interpretations, shall be furnished to the Engineer. Maximum particle velocity allowed shall be two (2) inches per second. To reduce annoyance to local residents, vibration should be kept as much below the two (2) inch per second level as possible and still permit efficient performance of the required demolition work.

The requirements presented herein shall not relieve the Contractor from the responsibility to avoid disturbing earth or rock beyond indicated and specified lines and levels.

2505.7 No Blasting Areas: No blasting of any kind for rock excavations or any other purpose will be allowed if so noted on the Plans.

2505.8 Open-Cut Method (Trenching):

- A. Scope:** This item establishes the requirements to be followed for pipeline excavation performed by the open-cut method (trenching).
- B. General:** Excavations for pipelines shall be accomplished by the open-cut method (trenching) except as specified or approved by the Engineer. Trenching shall be with a minimum inconvenience and disturbance to the general public.

The Contractor shall sort and stockpile the excavated material so the proper material is available for backfill. All unsuitable materials shall be removed from the site and disposed of in an approved location.

C. Trench Depths: All trenches shall be excavated to depths required for proper pipe embedment. Overdepth excavation shall be required when the subgrade is unstable. Overdepth excavations shall be backfilled with granular pipe embedment material unless otherwise directed by the Engineer.

D. Trench Walls: Undercutting of trench walls is not permitted.

E. Trench Widths:

1. Minimum Widths: Trench widths and pipe clearances shall be not less than that shown in the following table:

**MINIMUM TRENCH WIDTHS
AND PIPE CLEARANCES
(INCHES)**

Nominal Pipe Diameter	Trench Width 1*	Pipe Side Clearance 2*	Soil/Incompressible Pipe Bottom Clearance
4	22	6	4/6
6	22	6	4/6
8	22	6	4/6
10	24	6	4/6
12	27	6	4/6
15	30	6	4/6
18	34	6	4/6
21	39	7	4/9
24	43	7	4/9
27	48	8	4/9
30	54	8	4/9

1* Measured below a horizontal plane six (6) inches above the pipeline top.

2* Measured from the outside pipe barrel face to inside trench face.

2. Maximum Widths: The allowable maximum trench widths hereinafter specified apply only to that portion of the trench below the horizontal plane parallel to and six (6) inches above the pipe top.

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 the appropriate strength class of pipe embedment to provide safe support strength to the pipeline.

When the side clearance exceeds two and one-half (2 1/2) times the outside pipe diameter at either side of a flexible conduit, it shall be the Contractor's responsibility, at no additional cost to the City, to provide bedding adequate to develop the required lateral

support for the pipe and/or provide a pipe of sufficient strength class to accommodate the loading conditions as approved by the Engineer.

3. Trench Slope: The trench width above a horizontal plane six (6) inches above the pipe top may vary and side sloping is permissible unless otherwise specified.
4. Trench Shields: When trench shields are utilized by the Contractor, said shields or any part thereof shall not extend lower than six (6) inches above the proposed pipeline top, nor shall the maximum allowable trench width be exceeded.

F. Maximum Trench Widths for Reinforced Concrete and Ductile Iron Pipe: When reinforced concrete and ductile iron pipe is utilized, the strength class and the maximum allowable trench width as established by the Engineer will be shown on the Plans.

G. Option to Trenching: Contractor may perform excavation by tunneling methods as set forth herein at no additional cost to the City provided prior written approval for each such location is obtained from the Engineer.

2505.9 Tunneling, Boring and Jacking:

A. Scope: This item establishes the requirements to be followed for pipeline excavation performed by tunneling, boring and jacking methods.

B. General: Tunneling includes all underground horizontal excavations necessary to install the pipeline. The Contractor shall submit to the Engineer, prior to actual work, a written description of his proposed tunneling operation. It shall include the types and locations of shafts, methods to provide safe support strength for the pipeline when the shafts or bore pits exceed maximum allowable trench widths and other features that would affect the pipeline.

Tunneling shall be done with a minimum inconvenience and disturbance to the general public and abutting property Owners. No interruption of traffic will be permitted at any location.

C. Tunnel Cross Section: The tunnel shall be circular in cross section and of the size specified. Alternate size and shape may be submitted for consideration by the Engineer.

D. Construction:

1. General: All tunnel excavation shall provide an excavation conforming to the outside diameter of the casing and/or carrier conduit. The excavation shall be to an alignment and grade which will allow the carrier conduit to be installed to proper line and grade as shown on the Plans and as established in Section 2506.2.I - Installation.
2. Excavation: Conduct excavation in a manner to prevent disturbing overlying and adjacent material. Perform dewatering and chemical soil stabilization or grouting if necessary, due to existing field conditions.

SECTION 2506 INSTALLATION

2506.1 Scope: This section governs construction methods and procedures for the installation of gravity and pressure pipelines and appurtenances.

2506.2 General: All pipeline installations shall conform to the following requirements:

- A. Governmental Requirements:** Sanitary sewer line installation shall comply with these technical specifications.
- B. Trench Dewatering:** Contractor shall maintain a dry and stable trench, obtain necessary permits, and provide for the proper method of discharging such water from the work site at all times until pipeline installation is completed to the extent that hydrostatic pressure flotation or other adverse effects will not result in damage to the pipeline.

Proper dewatering techniques are the Contractor's responsibility. Contractor shall be responsible for obtaining all applicable water discharge permits. All work performed by the Contractor which is adversely affected by his failure to adequately dewater trenches will be subject to rejection by the Engineer. The Contractor shall repair and/or replace the affected pipeline without additional compensation.

- C. Drainage Course Crossing Encasement:** Any pipeline crossing a well-defined drainage course having less than (3) feet of cover over the pipe shall be encased in concrete. The length of encasement shall be as shown on the Plans or if not shown as specified by the Engineer.

- D. Trench Shoring and Bracing:** All shoring, bracing or blocking shall be furnished and installed as necessary to preserve and maintain exposed excavation faces, to protect existing improvements, to protect the proposed pipeline and to provide for safety.

Shoring or other methods for support of trench walls is the responsibility of the Contractor and shall be accomplished by methods that will not adversely affect pipeline alignment, grade and/or structural integrity.

All bracing, sheeting and/or shoring installed below a horizontal plane six (6) inches above top of proposed pipe shall not be disturbed or removed after pipe and/or pipe embedment has been installed unless otherwise specified. The bottom edge of a trench shield shall not extend lower than six (6) inches above top of proposed pipe.

- E. Pipe Embedments:** All pipe embedment shall conform to Class B Modified unless otherwise specified. Installation shall be in strict conformance with instructions for the appropriate Class being utilized.

All Class A concrete embedments for rigid conduits shall begin and end at a pipe joint.

F. Bedding Installation:

1. The trench subgrade shall be prepared to provide a uniform and continuous pipe support between pipe bells and joints.
2. Place and densify embedment material by shovel slicing or vibrating and prepare embedment material so that the pipe will be true to line and grade after installation. The pipe shall be protected from lateral displacement and deflection by pipe embedment material installed as specified for pipe embedment and as shown on the Standard Drawings. During embedment placement and compaction, care shall be taken to ensure

that the haunch areas below the pipe springline are completely filled and free of voids. Pipe shall not be installed out of round. No pipe shall be laid under unsuitable trench conditions.

3. After each pipe has been brought to grade, aligned, and placed in final position, deposit and densify by shovel slicing sufficient bedding material under the pipe haunches and on each side of the pipe to hold the pipe in proper position during subsequent pipe jointing, bedding, and backfilling operations. Place bedding material uniformly and simultaneously on each side of the pipe to prevent lateral displacement.
4. Place pipe that is to be bedded in Class A (concrete) embedment in proper position on temporary supports consisting of wood blocks or bricks with wood wedges. When necessary, anchor or weight the pipe to prevent flotation when the concrete is placed.
5. Place concrete for Class A (concrete) embedment or encasement uniformly on each side of the pipe and deposit at approximately its final position. Do not move concrete more than five (5) feet from its point of placement.
5. 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 material approved by the Engineer.

G. Pipe Embedment Designations and Descriptions:

1. Class A Embedment - Concrete Cradle, Arch or Encasement: Concrete encasement shall be installed where and as shown on the drawings and where, in the opinion of the Engineer, such pipe encasement is necessary because of unforeseen conditions encountered in the work. All pipe which is to be encased shall be suitable supported and blocked in proper position and shall be anchored against flotation.
 - a. All Class A embedments require A 618-1-4 concrete as specified in Section 2510.3.E except as otherwise specified. After initial set of concrete, one (1) foot of backfill material should be placed over the conduit or concrete. The backfill above this point shall not be placed nor sheeting removed until at least 48 hours after placement of the concrete. Time requirements may be adjusted by the Engineer to obtain structural integrity.
 - b. Class A embedments for all pipe shall be installed with reinforcing steel of not less than $p=0.4\%$, where p is the ratio of the area of steel to the area of concrete, or as otherwise specified. Reinforcing steel shall be uniformly spaced and have a minimum lap of 16 bar diameters.
2. Class B Embedment: The pipe shall be bedded in granular material, with a minimum thickness below the pipe as specified in Section 2505.8.E.
 - a. First Class: The granular material shall be placed to the horizontal center line of the pipe. The backfill from the horizontal centerline to a level not less than 12 inches above the top of pipe shall be carefully placed select earth backfill compacted to a minimum eighty-five percent (85%) of maximum density at an optimum moisture \pm or - 2% as defined in AASHTO 199 or ASTM D 698. The select material shall be

free from debris, organic matter, frozen material and rocks larger than one (1) inch. Class IV and Class V embedment materials, as defined in ASTM D 2321, shall not be used for bedding, haunching, or initial backfill of flexible pipe.

- b. First Class Modified: The backfill shall be the same as for First Class except all of the material used to a level not less than twelve (12) inches above the top of the pipe bell or coupling shall be bedding aggregate.
- 3. Class C Embedment: The pipe shall be bedded in granular material with a minimum thickness beneath the pipe as specified in Section 2505.8.E.

It shall be sliced under the haunches of the pipe to a height one-sixth (1/6) of the outside diameter of the pipe. Backfill above the bedding, to a point 12 inches above the top of pipe, shall be carefully placed select earth backfill compacted to a minimum eighty-five percent (85%) of maximum density as defined in AASHTO T99 or ASTM D 698.

H. Tees, Wyes and Building Service Lines: Tees (Ts), wyes (Ys), and building service lines shall be installed as shown on the Plans or specified herein.

- 1. Tees, wyes and saddles shall be installed at forty-five (45) degrees with pipe springline for pipe sizes eight (8) through 16 inches in diameter. Tees, wyes and saddles shall not be installed in pipe sizes greater than or equal to eighteen (18) inches in diameter. Tees, wyes and saddles cannot be installed within 12” of a bell end or joint.
- 2. Building service lines shall be installed with a straight alignment and at a uniform grade not less than two (2) percent unless otherwise specified and shall be embedded with Class B embedment. When a building service line grade exceeds twenty percent (20%), pipeline anchors shall be installed as required under Section 2506.2.K, with the first anchor not more than 12, nor less than seven (7), feet upstream of the tee or wye.
- 3. The Contractor shall maintain an accurate record for submittal to the Engineer of location, size and direction of each tee, wye, saddle and/or location, size and length of each building service line. Locations shall use the pipeline stationing as shown on the Plans or the distance from the first downstream manhole. In the event such records are not kept or are lost before final acceptance of the work, the required information shall be redetermined by the Contractor at no additional cost to the City.
- 4. Service lines shall be terminated and capped one (1) foot on the public side of right-of-way or easement lines.

I. Gravity Sewers: All gravity sewers shall be installed to the alignment, elevation, slope, and with pipe embedment as specified and/or shown on the Plans. Maintain the following tolerances from true alignment and grade between adjacent manholes:

Alignment	6 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.

J. Pressure Sewers (Force Main): All pressure sewers shall be installed with required pipe embedment to depths shown on the Plans (not less than 42 inches) and to a continuous slope when not shown. Approved air relief valves shall be installed at all locations shown on the Plans or where required by the Engineer.

The Contractor shall block and anchor the pipeline to accommodate thrust and testing forces at pipe deflections, bends, tees, and plugs in accordance with the Contract Documents. All damage caused by the Contractor's failure to provide adequate thrust restraint shall be corrected by the Contractor at no additional cost to the City.

K. Anchors: Pipelines shall be anchored in accordance with the table below:

<u>PIPELINE ANCHORS</u>	
<u>Percent of Grade</u>	<u>Center to Center Max. Spacing (Feet)</u>
15-35	36
35-50	24
50	16

The anchors shall be constructed in accordance with Concrete Collar Detail on Standard Drawing 25-1.

L. Pipe Laying: All pipe shall be installed in accordance with the pipe manufacturer's recommendations, except as modified herein.

1. Pipe laying shall not proceed if the trench width, as measured at the pipe top, exceeds the maximum allowable trench width. If this occurs, the Contractor shall submit to the Engineer for approval a better pipe bedding or pipe of sufficient supporting strength.
2. 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. When lifting HDPE with slings, only wide fabric choker slings capable of safely carrying the load shall be used to lift, move, or lower pipe and fittings. Wire rope and chain are prohibited on HDPE.
3. Rejected pipe and fittings shall be marked and removed from the Project Site at no cost to the City. 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.
4. Clean joint contact surfaces prior to jointing. Use lubricants, primers, adhesives or cutting tools as recommended by the pipe or joint manufacturer.
5. Pipe laying normally shall begin at the lowest point.
6. Lay all pipe straight between manholes. Excavate bell holes for each pipe joint bell. When jointed, the pipe shall form a true and smooth pipeline.
7. Pipe connecting to a structure shall be supported with Class A embedment, cradle or

encasement to the first joint outside the structure excavation. If flexible wall connections are used, Class B embedment may be used in lieu of concrete embedment, provided the height of backfill does not exceed the cover depths in Section 2505.8.F, resulting in loads exceeding the pipe's safe supporting strength.

8. 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 stormwater or other foreign matter.
9. When a sanitary sewer line crosses an existing pipeline and the clearance is less than two (2) feet, special embedment may be required.

M. Connection of Pipes of Dissimilar Materials: The connection of pipes of different materials shall be made using approved transition coupling and shall provide a permanent and watertight connection that will withstand the hydrostatic test pressure.

N. Water Line Clearances: Sanitary sewers and water lines shall be constructed a distance of ten (10) feet apart (edge to edge of pipe, not centerlines) when they are to be installed parallel to each other. Exception to this requirement shall be granted only upon written approval by the Kansas Department of Health and Environment.

Where sanitary sewer lines are to be installed over and across water lines, the sewer pipe shall be constructed of ductile iron for a distance of at least ten (10) feet in each direction from the crossing.

Where sanitary sewer lines are to be installed under and across water lines and a two (2) foot clearance cannot be obtained because of limiting grades or grades of existing structures, then the sewer pipe shall be constructed of ductile iron for a distance of at least ten (10) feet in each direction from the crossing.

Sanitary sewer force mains have the additional requirement of being located at least 2-foot clear and below waterlines. Sanitary sewer force mains shall not cross above water lines. Where it is not practical to maintain the required horizontal or vertical separation distance between a water line and a sanitary sewer force main, KDHE will consider proposals providing equivalent protection by other methods on a case-by-case basis, if supported by data from the design engineer.

2506.3 Detailed Installation Requirements: All pipes shall be installed in accordance with the following standards:

- ASTM D-2321 - ABS Solid Wall, ABS Composite Wall,
- ASTM D-2321 - PVC Solid Wall, PVC Composite Wall.
- ANSI/AWWA C 600 - Ductile Iron Pipe.
- Reinforced Concrete Pipe - Installed in accordance with American Concrete Pipe Association's "Installation Manual."
- ASTM D 2774 Underground Installation of Thermoplastic Pressure Piping.

2506.4 Casing and Carrier Conduits: Casing and carrier conduits shall be installed at required locations by methods acceptable to the Engineer. Installation of the carrier conduit shall be completed prior to installation of the adjacent portions of the pipeline to allow for

adjustments. Smooth wall casing pipe shall be welded steel construction, and shall be a new material with a minimum yield point of 35,000 psi. The pipe shall have a wall thickness as approved by the City Engineer.

A. Casing Types:

1. Steel Casing Pipe: Steel casing pipe is a non-flexible conduit and shall be designed to conform with one of the following design concepts (other methods, may be submitted to the Engineer for approval).
 - a. Method A: The steel casing conduit is considered a temporary construction means for the installation of the carrier conduit; therefore, cathodic and corrosion protection is not required provided that the carrier and its joints are structurally designed to withstand all possible loadings (live, earth and superimposed) which would otherwise be supported by the casing conduit, and to withstand all pressures necessary to install the required grout. All exterior voids around the casing conduits shall be filled with casing conduit grout (2503.5.F).
 - b. Method B: The steel casing conduit is considered a permanent installation to protect the carrier conduit and to support all loads, therefore, cathodic and corrosion protection and watertight removable end seals are required for the casing conduit. Care shall be exercised to prevent the carrier conduit from floating and receiving any load transfer from, the casing conduit unless it is designed for such loading. The void between casing and carrier conduits shall be treated as shown on the drawings. Cathodic and corrosion protection for method B shall be provided by two magnesium anodes, one at each end of the casing pipe, with a lead wire connected to the encasement pipe by thermite welding.
 - 1) Reinforced Concrete Casing Pipe: Reinforced concrete casing pipe is a rigid conduit and shall be installed in accordance with recommended procedures in the latest printing of the Concrete Pipe Design Manual prepared by American Concrete Pipe Association.

B. Casing Installation: Installation of casing shall be supervised by a foreman experienced in such work. Casing shall be installed by a combination of augering and jacking. Alignment and gradient shall be such that the carrier conduit can be installed to line and grade shown on the drawings.

Welding shall be performed by a person certified for the type of welding necessary. All welds shall conform to AWWA C 206.

C. Liner Plate Installation: Liner plates shall be assembled immediately following the excavation. Advance liner plates or casing continuously with excavation. All voids between liner and surrounding earth shall be filled with casing conduit grout forced in under pressure. As the pumping through any hole is completed, it shall be plugged to prevent the back-flow of grout. After lining installation is complete, it shall be cleaned of all debris and all leaks sealed.

D. Carrier Conduit Installation: After completion of the installation of the casing, the carrier conduit shall be carefully pushed or pulled through the casing in a manner that will maintain proper jointing of the pipe joints and provide required gradient and alignment. Corrosion

resistant factory made casing spacers shall be utilized for all installations. Sand fill shall be used when shown on the plans or required by the Special Provisions.

- E. Sand Fill:** The annular space between casing and sewer pipe shall be filled with sand from end seal to end seal if required. The fill shall be placed inside the casing in a manner that will not disturb the alignment and/or grade of the sewer pipe. Sand used in casing conduits shall be as specified in Section 2510.3.E. Sand shall be applied into the casing so that all space is filled.
- F. End Seals:** The ends of each casing pipe or tunnel liner shall be closed with corrosion resistant factory made end seals such as neoprene with stainless steel bands or as shown on the plans. The closures for each casing pipe or tunnel liner shall not be constructed until all testing of the line has been completed and accepted.
- G. Initial Testing:** Air pressure and/or exfiltration tests, as required, shall be successfully performed on the carrier conduit prior to filling the void between casing and carrier conduits with sand or sealing the casing conduit ends.
- H. Carrier Conduit Installed Without Casing:** Carrier conduits installed without casing shall be assembled at the entrance to the auger hole and carefully pushed or jacked through the opening using a method designed to prevent disturbing the assembled joints. Auger holes shall be sized to accommodate the carrier conduit with a minimum of annular space around the conduit. When finally in place, carrier conduit shall be true to the line and grade required on the Plans.

2506.5 Location Wire and Tape:

- A. General:** Location wire shall be installed for all force mains. Marking tape shall be installed above all force mains installed by open trench excavation.
- B. Installation:** Location wire shall be secured above force mains and connected to valve boxes, cleanouts and manholes as shown on Standard Drawings. Splicing shall be held to a minimum and will not be allowed between valve risers, cleanouts and manholes. If distances between the previously mentioned appurtenances become excessive, location wire access boxes shall be installed to limit lengths between location wire access to less than 1,000 feet. Access boxes shall be Clay & Bailey No. 2194 or approved equal valve lids and shall have "Sewer" cast into the lid.

Before project acceptance the contractor in the presence of City staff will test the electric continuity of all installations. Contractor shall be responsible for the cost of repair and any retesting required.

The marking tape shall be installed directly above the centerline of the pipe and 18 to 24 inches below finish grade.

SECTION 2507 BACKFILL

- 2507.1 Scope:** This section governs the furnishing of all labor, equipment, tools and materials to properly backfill trenches and structures.

2507.2 General:

- A. Debris:** All trash and debris shall be removed from the pipeline excavation prior to backfilling.
- B. Backfilling:** Unless otherwise specified, all sewer trenches and excavation around structures shall be backfilled to the original surface of the ground with suitable earth or earth and rock. When an earth and rock mixture is used, it shall be placed and thoroughly consolidated with sufficient earth to completely fill all voids between the rocks.
- C. Lifts:** The backfill material shall be placed in lifts not to exceed two (2) feet in depth. Each lift shall be compacted to the required density prior to the next lift being placed.
- D. Commercial Sand: Commercial sand backfill shall not be used.**
- E. Gardens:** In areas marked "garden" or "flower garden," the original topsoil shall be replaced to original elevation and depth. (Minimum depth shall be 12 inches).
- F. Backfill Material:** Backfill material shall be carefully placed to avoid damage to or displacement of the pipe and other exposed utilities or structures.
- G. Backfill Conditions:** Backfill shall not be placed when material contains frost, is frozen, or a blanket of snow prevents proper compaction. Contractor shall remove waste material, trees, organic material, rubbish, or other deleterious substances.
- H. Rock Backfill:** No rock whose greatest dimension exceeds three (3) inches shall be placed in any trench excavation as backfill.

2507.3 Backfill Under Pavements, Driveways, Sidewalks, and Other Paved Areas:

Under areas to be paved, the backfill materials from the top of the pipe embedment to bottom of pavement shall be placed as per standard drawing 25-1.

2507.4 Backfilling In Areas Other Than Under Pavements, Driveways, Sidewalks, and Other Paved Areas:

From the top of the pipe embedment (as defined in Section 2506.2.G.) to a point at grade the backfill material shall be compacted to no less than 90% of maximum density at optimum moisture plus or minus 2% as determined by ASTM 698.

2507.5 Backfill Around Structures:

No backfill shall be placed over or around any structure until the concrete or mortar 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 the structure that would cause any movement of the structure. Any damage caused by premature or unbalanced backfill or by the use of equipment on or near a structure will be the responsibility of the Contractor.

No rock larger than three (3) inches maximum dimension shall be placed within the excavation.

SECTION 2508 RESTORATION

2508.1 Scope: This section covers all work required in surface restoration on private and public properties that are disturbed by construction.

2508.2 General: The Contractor shall restore the project site to conditions equal to or better than those existing prior to entry unless otherwise specified.

A. Safety Measures: Maintain adequate safety signs, barricades and lights until final restoration of work area is completed.

B. Public Property: Public property shall be restored to the requirements of the public body having jurisdiction.

2508.3 Clean-Up: The Contractor, upon completion of installation and backfill operations, shall prepare the area for final grading including but not limited to the following items:

A. Timing: Clean-up shall follow the backfilling operations as closely as possible.

B. Excess Material: Excess material shall be removed from the site and disposed of in an approved location.

C. Tool and Equipment: Tools, equipment and construction material shall be removed except in designated storage areas along the pipeline route.

D. Drainage: Restore surface and sub-surface drainage and provide temporary wash checks where necessary.

2508.4 Finished Grading: The Contractor shall finish grade the area to lines and grades shown on the Plans or if not shown to those that existed prior to the area being disturbed. Special attention shall be directed to assure surface drainage. The area shall be smoothed by raking or dragging.

2508.5 Seeding: The requirements set forth under Section 2401 - Seeding shall be used as if fully written herein.

2508.6 Sodding: The requirements set forth under Section 2402 - Sodding shall be used as if fully written herein.

2508.7 Pavement Replacement

A. Scope: This section covers the furnishing of all labor, equipment, tools and materials in the performance of all work for the replacement of pavement including sidewalks, driveways and curbing as shown on the Plans and in the Special Provisions.

B. Definition: Pavement replacement as used herein shall mean reconstruction of the entire structural section of all pavements removed in excavated areas, including sidewalks,

driveways and curbing and all damaged pavement surfaces outside of excavation limits.

C. General: Replacement of pavement shall proceed in accordance with the traffic control plans and/or approved construction schedule.

1. Replacement of pavement shall proceed in accordance with the traffic control plans and/or approved construction schedule.
2. Prior to pavement replacement, all edges that were previously cut but have been subsequently damaged shall be recut and all adjacent undermined and heaved pavement shall be removed.

2508.8 Fences: All existing fencing damaged and/or removed prior to construction shall be restored to a condition not less than that which existed prior to construction.

2508.9 Walls: Retaining and architectural walls, if disturbed or damaged, shall be restored, architecturally and structurally to conditions not less than that which existed prior to construction.

2508.10 Trees, Shrubs and Bushes: Any tree, shrub or bush replaced shall be planted outside the permanent sanitary sewer right-of-way and shall be of the same species as the removed tree, shrub or bush. Any tree, shrub or bush specie that is prohibited by local restrictions shall be substituted with a related species. Replacement planting shall conform to the guidelines ANSI-Z60.1-1980 "American Standard for Nursery Stock" specified by the American Association of Nurserymen. The contractor shall notify the property Owners at least two weeks prior to the start of construction so property Owners can remove small plants and flowers.

SECTION 2509 TESTING

2509.1 Scope: This section governs the furnishing of all labor, equipment, tools and materials, and the performance of any or all acceptance tests.

2509.2 General: The Contractor shall furnish all labor, equipment, materials and reports for the required acceptance tests. All pipelines, including building service lines, shall undergo and pass all required tests to determine soundness and workmanship. Pipelines that do not conform to the project requirements shall be repaired and/or replaced and shall be retested until the pipeline meets the project requirements. Test shall be witnessed by city personnel, and the results shall be recorded by the Contractor and a copy shall be submitted to the Engineer. No testing shall be performed before backfill and compaction operation has been completed.

2509.3 Alignment and Grade: Alignment, grade and visible defects shall be checked as follows:

A. Visual Internal Inspection:

1. Contractor shall clean pipe of excess mortar, joint sealant and other dirt and debris prior to inspection.
2. Sewer will be inspected by flashing a light between manholes and/or by physical passage

to determine the presence of any misaligned, displaced, or broken pipe and other defects.

- B. Television Inspection:** Sewer lines installed under this project are subject to inspection by closed circuit television at the City's expense.

2509.4 Infiltration - Exfiltration: Hydrostatic or air pressure tests shall be conducted on sewers before acceptance by the City. For sewers with a diameter less than 24 inches, the infiltration-exfiltration shall not exceed 200 gallons per day per inch of nominal diameter per mile of sewer line for any section of the system. For sewers with a diameter 24 inches or greater, infiltration-exfiltration shall not exceed 6,000 gallons per day per mile of pipe.

- A. Infiltration:** Where sewers are laid within the ground water table, infiltration testing shall be conducted. Where evidence of infiltration is discovered by the Engineer, the Contractor shall install weirs or other suitable flow rate measuring devices adequate to determine to the satisfaction of the 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 pipeline at no additional cost to the city. Following repair of the pipeline, the Contractor shall remeasure infiltration flow rates and make additional repairs until an acceptable infiltration flow rate is achieved.
- B. Exfiltration:** Exfiltration tests shall be performed by the Contractor using one or a combination of methods as set forth below. Each section of gravity pipeline between manholes and/or structures after backfill shall be tested after backfill has been completed.

1. Hydrostatic Tests for Gravity Systems:

- a. Test section shall be filled not less than 12 hours prior to testing. Refill test section prior to performing test.
- b. Perform at depths of water as measured above center line of pipe of not less than two (2) feet nor more than 10 feet (consideration shall be given for water table above said center line). Maintain test as necessary to locate all leaks but not less than two (2) hours.

2. Hydrostatic Tests for Pressure Systems:

- a. Sectionalizing: Test in segments between sectionalizing valves, between a sectionalizing valve and a test plug, or between test plugs. Contractor shall furnish and install test plugs at no additional cost to the City, including all anchors, braces, and other devices to withstand hydrostatic pressure on plugs. Contractor shall be responsible for any damage to public or private property caused by failure of plugs. Limit fill rate of line to available venting capacity.
- b. Pressure and Leakage Test: The Contractor shall perform hydrostatic pressure and leakage tests of DIP and PVC in accordance with KDHE's Minimum Design Standards, Appendix C. Leakage test shall be conducted concurrently with the pressure test.

For HDPE, duration of the test shall be not less than two (2) hours. It is recommended that pressure be stabilized for one (1) hour prior to leakage test. Test pressure shall be at least 1.5 times design pressure. Maintain pressure throughout test

±5 psi of test pressure.

Line leakage shall be the total water amount introduced into the line, as measured by a meter during the leakage test. The pipe is acceptable when leakage does not exceed that determined by the following formula:

$$Q = 0.0075 DLN$$

Where: Q = Allowable leakage (gallons/hour)
D = Pipe nominal diameter (inches)
L = Length of section tested (thousand feet)
N = Square root of average test pressure (psi)

For reference, the allowable leakage for 1000 feet of pipe at 150 psi in gallons per hour is as follows:

<u>Pipe Diameter (inches)</u>	<u>GPH/1000' of Pipe</u>
4	0.37
6	0.55
8	0.74
10	0.92
12	1.10
16	1.47
20	1.84
24	2.21
30	2.76
36	3.31

When testing against closed metal-seated valves, an additional leakage per closed valve of 0.0078 gal/hr/in of nominal valve size shall be allowed. When hydrants are in the test section, the test shall be made against the closed hydrant.

In the event that the line under test contains pipe of more than one size, the allowable leakage shall be calculated separately for each size and corresponding length of line, and then added to obtain the total allowable leakage for the entire line.

3. Air Testing of Gravity Systems:

- a. Contractor may perform air tests for all pipe (except concrete) for all sizes.
- b. Furnish all facilities required including necessary piping connection, test pumping equipment, pressure gauges, bulkheads, regulator to avoid overpressurization, and all miscellaneous items required.
- c. The pipe plug for introducing air to the sewer line 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 valve 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 line.

- d. 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 1/2 inch N.P.T.

Calibration data will be supplied with all pressure test gauges. Certification of pressure test gauge will be required from the gauge manufacturer. This certification and calibration data will be available to the Engineer whenever air tests are performed.

- e. Plug ends of line and cap or plug all connections to withstand internal pressure. One of the plugs provided must have two taps for connecting equipment. After connecting air control equipment to the air hose, monitor air pressure so that internal pressure does not exceed 5.0 psig. After reaching 4.0 psig, throttle the air supply to maintain between 4.0 and 3.5 psig for at least two (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 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.

<u>Pipe Size</u>	<u>Required Time per 100 LF</u>	<u>Maximum Required Time</u>
8"	70 sec.	227 sec.
10"	110 sec.	283 sec.
12"	158 sec.	340 sec.
15"	248 sec.	425 sec.
18"	356 sec.	510 sec.
21"	485 sec.	595 sec.
24"	634 sec.	680 sec.
27"	765 sec.	765 sec.
30"	851 sec.	851 sec.
33"	935 sec.	935 sec.

If an air test fails to meet above requirements, repeat test as necessary after all leaks and defects have been repaired and backfilled. Prior to acceptance, all constructed sewer lines shall satisfactorily pass the low pressure air test.

- f. In areas where ground water is known to exist, install a one-half (1/2) inch diameter capped pipe nipple approximately 10 inches long through manhole wall on top of one

of the sewer lines entering the manhole. This shall be done at the time the sewer is installed. Immediately prior to the performance of the line acceptance test, ground water level shall be determined by removing pipe cap, blowing air through pipe nipple into the ground so as to clear it and then connecting a clear plastic tube to pipe nipple. The hose shall be held vertically and a measurement of height in feet of water shall be taken after the water stops rising in this plastic tube. The height in feet shall be divided by 2.3 to establish the pounds of pressure that will be added to all readings.

2509.5 Deflection Test

- A. General:** Flexible and semi-rigid pipelines shall be tested for deflection, by pulling a mandrel through the entire length thereof.
1. The mandrel (go/no-go) device shall be cylindrical in shape and constructed with nine (9) 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 accompanying table. The "D" mandrel dimension shall carry a tolerance of +/- 0.01 inch. Allowances for pipe wall thickness tolerances or ovality (from heat, shipping, poor production, etc.) shall not be deducted from the "D" dimension but shall be counted in as a part of the five (5) percent or lesser deflection allowance. Contact length (L) shall be measured between points of contact on the mandrel arm. The length shall not be less than as shown in the accompanying table.
 2. The Engineer shall be responsible for approving the mandrel. Proving rings shall be used to verify this.
 3. The mandrel shall be hand-pulled by the Contractor through all flexible sewer lines. Any sections of sewer not passing the mandrel test shall be uncovered and the Contractor, at no additional cost to the City, shall reround or replace the sewer to the satisfaction of the Engineer. These repaired sections shall be retested.
 4. The testing shall be conducted after final trench backfill.

<u>Nominal Diameter</u>	L	D and L Dimensions For 9 Arm Mandrel		
		D		
		<u>SDR-35</u>	<u>SDR 26</u>	<u>SDR 21</u>
8"	8"	7.52"	7.37"	7.41"
10"	10"	9.40"	9.21"	9.24"
12"	12"	11.19"	10.96"	10.96"
15"	15"	13.70"	13.42"	N/A
18"	18"	16.76"	N/A	N/A
21"	21"	19.74"	N/A	N/A
24"	24"	22.21"	N/A	N/A
27"	27"	25.03"	N/A	N/A

2509.6 Soil Density Tests: Compaction tests shall be performed as specified in the Special Provisions. If so specified, all compaction tests shall be performed by a testing laboratory approved by the Engineer.

A. Testing Methods: Testing shall be in accordance with the following:

1. **Maximum Density:** Maximum density shall be determined by the standard proctor analysis method as defined by AASHTO T99 or ASTM D 698.
2. **Density of Soil in Place:** The density of soil in place shall be determined by the analysis methods as defined by ASTM D 1556, or ASTM D 2167, or ASTM D 2922.

B. Method of Payment: The Contractor shall pay all costs for density tests. Tests shall be required as follows:

1. For pipelines located within street or alley rights-of-way, density tests representative of each three (3) foot of trench depth shall be taken at 500 linear foot intervals along the lines or at each cross street.
2. For pipelines located outside of street or alley rights-of-way, density tests representative of each three (3) foot of trench depth shall be taken at 1,000 foot intervals along the lines.

C. Additional Tests: The Engineer may require additional density tests with payment as follows:

1. Test results conforming to specified densities will be paid for by the City.
2. Test results not conforming to specified densities shall be paid for by the Contractor at no additional cost to the City.

SECTION 2510 MANHOLES AND SPECIAL STRUCTURES

2510.1 Scope: This section governs the furnishing of all labor, equipment, tools, and materials, and the performance of all work incidental to the construction of manholes, drop manholes and special sewer structures complete with covers, steps, fittings and appurtenances as required in accordance with the Plans and Special Provisions.

2510.2 General: As used herein special structures refers to manholes on large sewers, special junction structures, metering stations and similar structures constructed on the pipeline. Manholes and special structures may be constructed of precast concrete sections, or cast-in-place concrete.

2510.3 Manhole Materials:

A. Brick: The use of brick for manhole materials is not permitted.

B. 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 twenty-four (24) hours per ASTM C 109. The placement time shall be not less than 45 minutes based on initial set per ASTM C 191.

C. Waterproofing:

1. **Exterior:** Waterproofing shall be an asphaltic coating, conform to ASTM D 449, and

marketed by the manufacturer for coating of subsurface structures. Exterior surfaces shall be completely coated.

2. **Interior:** Where specified, interior surfaces (which are exposed to raw sewage and sulfide gases) shall be coated with a product that is a 100% solids, moisture tolerant, solventless epoxy structural lining resin as provided by Citadel Technologies, Inc. or Chemtron International, Inc. The epoxy lining shall be applied using temperature controlled, plural component spray equipment in accordance with the manufacturer's recommendations. The minimum average thickness of the resin shall be 125 mils. The applicator shall be certified by the epoxy lining manufacturer and a copy of the applicators certification shall be provided to the City.

D. Precast Concrete: Precast concrete manholes shall conform to ASTM C 478 with the following modifications:

1. Wall thickness not less than one-twelfth (1/12) of inside diameter or four (4) inches, whichever is greater, shall be used when the manhole depth is less than sixteen (16) feet; one-twelfth (1/12) of inside diameter plus one (1) inch or five (5) inches, whichever is greater, shall be used when manhole depth is sixteen (16) feet or greater.
2. Cement, Fine Aggregate, Coarse Aggregate and Water used in the manufacture of precast manholes shall be as specified in Section 2510.3.E.
3. Developed bases shall be used where practical. The diameter of the base pad shall be at least twelve (12) inches greater than outside diameter of the manhole.
4. Pipe openings shall be circular or horseshoe shaped with surfaces grooved or textured to improve mortar bond. Flexible gaskets shall be used with developed base manholes. Flexible gaskets shall be Press-wedge, A-Lock, or approved equal.
5. The minimum distance from the invert of the downstream pipe to the top surface of the base shall be three (3) inches.
6. Joints between manhole sections, adjustment rings, and below the ring and cover shall be sealed with preformed bitumastic sealants, Kent-Seal, Ram-Nek, E-Z Stick or approved equal. The minimum bead dimension shall be one inch.
7. Joints between manhole sections, adjustment rings, and below the ring and cover shall be sealed with a minimum 6" wide joint wrap in addition to the bitumastic. The joint wrap shall be Ez-Wrap-Rubber as manufactured by Press Seal Gasket Corporation, Riserwrap by Pipeline Seal and Insulator, Inc., Infi-Shield as manufactured by Sealing Systems, Inc., or approved equal.
8. Internal chimney seals will be installed on all manholes between the frame and cone. The internal chimney seal shall be Cretex Classic Internal Chimney Seal or approved equal.

E. Manhole and Special Concrete: Manhole and special concrete shall conform to "The Mid-West Concrete Industry Board Incorporated" (MCIB) Specifications and to the requirements therein for the MCIB Mix Number specified on the drawings or as provided herein. All concrete shall cure for a minimum of twenty-four (24) hours prior to backfill.

1. **Standard Concrete:** Standard concrete used for concrete encasements and embedments, thrust blocks, pipe anchors, pipe collars, etc. shall be MCIB Mix Number A618-1-4 (4000 psi 28-day strength), unless otherwise specified.
2. **Structural Concrete:** Structural concrete used for aerial crossing piers, wetwell walls, manhole walls, bases, inverts, and flat slabs, etc. shall be MCIB Mix Number A618-1-2, (4000 psi 28-day strength), unless otherwise specified.
3. **Admixtures:** Air-entraining admixtures shall provide air content within the range of 4 1/2 to 7 1/2 percent by volume as measured by the pressure method. (ASTM C 231). Air entraining admixtures shall meet the requirements of ASTM C 260.
4. **Portland Cement:** Portland cement shall conform to ASTM C 150 Type 1. Where high early strength is desired, Type III can be used.
5. **Fine Aggregate:** Fine aggregate shall be clean, natural sand meeting the requirements of ASTM C 33. Grading shall be within the limits as set forth by MCIB.
6. **Coarse Aggregate:** Coarse aggregate shall be limestone meeting the requirements of ASTM C 33. The sum total of all deleterious material shall not exceed the requirements of ASTM C 33.
7. **Water:** Water shall be clean and free from deleterious substances. Only potable water will be acceptable without testing.
8. **Corrosion Inhibitor:** ConShield or approved equal added to concrete mix per manufacturer's directions.

F. Reinforcement Steel: Reinforcement steel shall conform with the following minimum requirements:

1. **Design:** Reinforcing steel shall conform to one of the following.
 - a. Welded Wire Fabric - ASTM A 185
 - b. Reinforcing Bars - ASTM A 615, Grade 40, or Grade 60
 - c. Fabricated Steel Bar and Rod Mats - ASTM A 184, Grade 40, or Grade 60
2. **Fabricating Tolerances:** Tolerances for concrete reinforcement shall conform to the following requirements:
 - a. Sheared length = +/- 1 inch
 - b. Stirrups, ties, and spiral = +/- 2 inches
 - c. All other bends = +/- 1 inch.

G. Iron Castings: Casting shall conform to the requirements of ASTM A48, Class 35B. Castings shall be clean and without surface defects that will impair serviceability. Plugging or filling of holes or other defects will not be permitted. Parting fins and pouring gates shall

be removed. If castings arrive on the job without a foundry coating, one coat of tar paint shall be applied. Before painting, all castings shall be thoroughly cleaned and properly supported. All loose rust shall be removed by wire brushing. Castings shall not be handled until the paint is dry and hard.

1. Rings and Covers: Rings and covers shall meet the following minimum requirements:

- a. Manhole rings and covers shall be EJIW No. V1383 with 41383211 ring , Clay & Bailey No. 2008BV, Deeter No. 1315 or approved equal. The exception shall be for use on shallow manholes where manhole covers shall be Clay & Bailey No. 2020 or approved equal. Manhole covers shall have cast thereon the words “SANITARY SEWER”.
- b. Bearing surfaces between the ring and cover shall be machine finished or ground to assure interchangeability and a nonrocking fit in any position.
- c. Provision shall be made for opening, such as concealed pick hole(s).
- d. When bolt-down type manhole rings and covers are required and specified, EJIW No. 1045 or Clay & Bailey No. 2014OR 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 walls with not less than four (4) three-fourths (3/4) inch diameter steel bolts embedded a minimum of 14 inches, except where the entire ring is embedded in a concrete top slab.
- e. Rings and bolt-down covers shall be provided with machined surfaces, O-ring gaskets and five-eighths (5/8) inch hex head brass cover bolts. Cover bolt heads shall fit flush or below the top of the cover. The o-ring rubber gasket shall be neoprene or other synthetic, sixty (60) plus or minus five (5) hardness when measured by ASTM D 2240 type durometer.

2. Steps – Not allowed

2510.4 Manhole Site Preparation: Manhole site preparation shall be governed by Section 2504.

2510.5 Manhole Excavation:

- A. Excavation:** Excavation for manholes and special structures shall be governed by this Section and Section 2505. It shall be achieved in a suitable and orderly manner providing a minimum disturbance to the general public.
- B. Depth of Excavation:** Depth of excavation shall be to that required for proper installation of the manhole or structure. Over-depth excavation may be required by the Engineer if the subgrade is unstable. Over-depth excavation due to unstable subgrade shall be backfilled as required by the Engineer. Over-depth excavation occurring through an oversight by the Contractor shall be backfilled as required by the Engineer at no additional cost to the City.
- C. Side Clearances:** Side clearances outside the manhole and/or structures shall be no greater than necessary to allow for forming, connection of piping, proper application of special coatings, if required, and to permit inspection. When concrete is to be placed directly against

excavated faces, excavation shall be sufficiently outside of the manhole or structure to provide not less than three (3) inches of concrete cover over the steel reinforcement

2510.6 Manhole Installation: Manhole installation shall be governed by this Section and Section 2506. It shall be performed by the Contractor on a schedule that will provide an orderly progression of the work.

A. Bases:

1. Precast developed bases shall be reinforced in accordance with ASTM C478.
2. If preferred developed bases are not used, poured concrete bases shall be used. Developed bases shall be installed on a maximum of four (4) inches of crushed rock. Depths exceeding this amount shall be filled with mass concrete.
3. Poured-in-place bases shall have a minimum thickness of eight (8) inches. When poured-in-place bases are used, the invert shall be poured monolithically with the base. The bottom wall sections shall be embedded in the base section a minimum of three (3) inches. The bottom precast wall section shall not be set upon a previously poured base. Solid concrete blocks shall be used for supporting and leveling the wall section prior to pouring the base.

B. Inside Dimensions: The minimum horizontal clear distance in the barrel of the manholes shall not be less than four (4) feet unless otherwise specified on the Plans.

C. Precast:

1. 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.
2. Inspection: Precast concrete shall be inspected when delivered. Rejection of defective or cracked precast concrete components shall be in accordance with ASTM C4118.
3. Wall Thickness: Wall thickness shall conform to the requirements of Section 2510.3.E.
4. Construction: Precast sections shall be cleaned of all dirt, grass, and other deleterious matter. Seal each joint (including adjustment rings and castings) with a double bead of preformed bitumastic joint sealant. Joints shall be sealed with wrap in addition to the bitumastic sealant. Chimney seals will be installed on all new manholes. Wrap and chimney seals shall not be installed until the completion of vacuum testing if any. Lift holes shall be patched with non-shrink grout.

D. Cast-In-Place:

1. Wall Thickness: Wall thickness shall conform to the dimensions as shown on the drawings.
2. Construction: Reinforcement steel shall be placed as shown on the drawing. Tie-holes shall be patched with non-shrink grout. Wall sleeves, where required, shall be installed

as shown on the drawings. Water stops shall be installed at the wall and slab connection and shall be of the size, thickness and material as shown on the drawings.

3. Waterproofing: Interior protective coatings, where required, shall conform to the material specifications. Application shall conform to the manufacturer's recommendation.
- E. Top Slabs:** Thickness shall conform to the dimensions and reinforcement steel shall be placed as shown on the drawings.
- F. Pipe Stubs:** Stubs shall be installed at the locations, angles, elevations and of the materials as shown on the drawings. A water-tight removable stopper shall be installed in each pipe stub. Pipe stubs shall be installed so that a pipe joint will be two (2) feet or less from the outside manhole wall.
- G. Inverts:** Inverts shall be structural concrete and steel-troweled to produce a dense, smooth finish. The invert channel shall be 'U' shaped in cross section and extend upward one-half of the inside pipe diameter. Smooth transitions shall be formed for pipes of different sizes, elevations and bends. The invert bench shall be sloped to drain.
- H. Steps:** Not allowed.
- I. Top Elevation:** The finished top elevation of manhole castings shall conform to the following unless otherwise shown on the plans or directed by the Engineer:
1. 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.
 2. In non-pavement areas, the top of the casting shall be not more than six (6) inches above the surrounding ground nor less than the sod's upper root limit. The final elevation shall be at a point where water will not pond over the manhole cover.
- J. Manhole Adjustment:** All new manholes will be provided with adjustment ring(s) underneath the casting as shown on Plans. The joints shall be sealed with preformed bitumastic sealant. The maximum allowable adjustment distance between the top of the cone and the bottom of the casting shall be 12 inches. If the top of an existing manhole is required to be raised to an elevation that will exceed the maximum adjustment distance or lowered more than the adjustment rings will allow, all vertical adjustments shall be made to the barrel of the manhole. Under no circumstances shall more than two adjustment rings be installed. If more adjustment is required, smaller adjustment rings shall be removed.
- K. Castings:** Castings shall be installed with the mud ring inserted inside the manhole opening and resting on a minimum of two rows of preformed bitumastic sealer. Bolt-down castings shall be held in place as shown on the Plans.

2510.7 Manhole Backfilling: Manhole backfilling shall be governed by Section 2507.

2510.8 Restoration: Restoration shall be governed by Section 2508.

2510.9 Manhole Testing:

- A. Scope:** This section governs the required testing of manholes and structures not otherwise set forth.
- B. General:** All newly constructed manholes and existing manholes that have been repaired or restored or manholes constructed over existing sewers shall be tested by the Infiltration and Inflow Test Method or by the Vacuum Test Method. All lift holes shall be plugged with non-shrink mortar, as approved by the Engineer prior to testing.
- C. Infiltration and Inflow Testing:** Manholes shall be dye water tested in the presence of the Engineer. The dye water test shall consist of injecting a concentrated dye and water solution approximately 12 inches below the ground surface and outside of the manhole frame. Dyed water shall be injected around the frame until the ground is saturated, as evidenced by surface ponding. Each manhole, will be observed for a minimum period of five (5) minutes after dye water injection. Manholes observed to be actively leaking, greater than 0.02 gpm (approximately 10 drips per minute) from a single source will not be accepted. Manholes failing the test will be repaired and retested.
- D. Vacuum Testing:** The contractor shall plug all pipe connections to the manhole using pneumatic plugs. The pneumatic plugs should be placed into the pipe after the inside surface has been cleaned. Air shall be introduced into the plugs to 25 psig. Bracing can be used to ensure that the plugs are not pulled into the manhole during vacuum testing. After the manhole has been properly prepared, the vacuum tester shall be installed. The test head shall be placed on top of the casting or fit inside the casting in a manner which incorporates the casting and all adjusting and adaptor rings into the vacuum test. The vacuum pump shall be connected to the outlet port with the valve open. The outlet valve shall be closed after a vacuum draw of 10 inches of Hg. has been obtained. The test shall pass if the vacuum remains at 10 inches Hg. or drops to 9 inches Hg. in a time greater than one minute. If the manhole fails, the contractor shall locate the leak and make proper repairs and then re-test.
- E. Visual Inspection:** A visual inspection will be performed for each manhole by the engineer after the manhole has met the testing requirements and is considered in its final state. The inspection shall determine the completeness of the manhole. Any defects identified shall be repaired to the engineer's satisfaction.

SECTION 2511 MEASUREMENT AND PAYMENT

2511.1 Measurement: The quantities of completed work will be measured in the following units. All measurements will be plan measure except for authorized changes.

- A. Open Trenched:** Measurement of various size, type and depth of pipe will be to the nearest 0.1 foot for each line between structures and made to the inside face of the connecting structure.
- B. Tunneled, Bored or Jacked:** Measurement will be to the nearest 0.1 foot for the limits of tunneling, boring or jacking as shown on the plan.
- C. Embedment or Encasement:** Concrete embedment or encasement will be measured by the lineal foot of each size and type.
- D. Manhole:** Measurement will be made for the applicable type, size and depth of manhole as

listed in the proposal. The depth shall be determined by measuring from the top of the casting to the outlet pipe flow line to the nearest 0.1 foot where applicable.

2511.2 Payment: Payment will be made at the respective unit or lump-sum price listed in the proposal and shall be full compensation for all labor, materials, and equipment necessary to complete the respective unit in place. There will be no separate measurement or payment for any item of work not specifically identified and listed in the proposal, and all such work shall be considered a subsidiary item with all costs pertaining thereto included in the prices for other items listed in the proposal. At the Engineer's option, partial payment may be made for any lump sum item listed in the proposal, providing that the Contractor is diligently and satisfactorily pursuing full completion of such partially complete item in accordance with the approved job progress schedule.

END OF SECTION