

**CITY OF LEAVENWORTH
KANSAS**

**STANDARD SPECIFICATIONS
FOR
SEWER LINE CONSTRUCTION**

**Standard Specifications #21749
Approved January 1991
Revised and Approved April 1996**

**Michael G. McDonald, P.E.
Director of Public Works/City Engineer**

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December 1990**

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SPECIAL PROVISIONS

It is further agreed between parties hereto that this contract is made subject to the following provisions and stipulations:

1. DISCREPANCY

In event of a discrepancy between the General Conditions and/or the Special Provisions, the Special Conditions will govern.

2. SUBSURFACE CONDITIONS

The results of test borings shown on the drawings are for information only. The test hole information is not a part of the Contract Documents. There is no express or implied guarantee as to the accuracy of the data nor of the interpretation thereof. The Contractor must form his own opinion of the character of the materials which will be encountered from an inspection of the ground, from his own interpretation of the test hole information, and from such other investigation as he may desire.

3. SHORING AND SAFETY

The Contractor shall provide adequate jacks and shores and/or a metal sled or may widen the ditch excavation in such a manner as to adequately protect the workmen who are laying the pipe. It is understood that if the Contractor elects to widen the excavation, it is his responsibility at no extra charge to the City of Leavenworth to recompact the entire excavated area. In any event, the City of Leavenworth expects the Contractor to protect his workmen who are installing the sewer.

4. BLASTING

The Contractor shall comply with all laws, ordinances and applicable safety code requirements and regulations relative to the handling, storage and use of explosives and the protection of life and property and he shall be responsible for all damage thereto caused by his blasting operations.

Where necessary for adequate protection of life or property, in the opinion of the Engineer, suitable weighted plank coverings or mattresses shall be provided 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 other backfill or embankment materials except as specified or directed.

5. RESPONSIBILITY OF CONTRACTOR FOR BACKFILL SETTLEMENT

The Contractor shall be responsible, financially and otherwise for:

- a. Any and all settlement of trench and other backfill which may occur from the time of original backfilling until the expiration of a period of one (1) year from and after the date of final acceptance of the entire contract under which the backfilling work was performed.
- b. The refilling and repair of all backfill settlement and the repair or replacement to the

original or a better condition of all pavement, top surfacing, driveways, walks, surface structures, utilities, drainage facilities, sod and shrubbery which have been damaged as a result of said backfill settlement or which have been removed or destroyed in connection with backfill replacement operations.

- c. Any and all damage claims filed with or court actions brought against the City for and on account of any damage or damages directly or indirectly caused by said backfill settlement.

6. MAINTENANCE OF OPERATIONS OF EXISTING SEWERS

It is absolutely essential that all existing sanitary sewers be kept in service at all times. If, during construction of the new sewer mains or manholes or any other operation in connection with the project, existing service is interrupted due to construction operations of any kind, the Contractor shall effect immediate repairs acceptable to the Engineer and further repair any damage caused by overflow or other causes by such damage to sewer lines. If temporary repairs cannot be effected in sufficient time to prevent damage to property or avoid nuisance or unsanitary conditions, the Contractor shall provide necessary pumping equipment, suitable tank trucks or other equipment to provide continuous operation of all sanitary sewer line.

7. PROTECTION CONSIDERATIONS

A. Separation of Water Mains and Sewers

- 1. Gravity Sanitary Sewers - When potable water pipes and gravity sanitary sewers are laid parallel to each other, the horizontal distance between them shall be not less than 20 feet (3.0m). The distance shall be measured from edge to edge. The laying of water pipes and sanitary sewers shall be in separate trenches with undisturbed earth between them. In cases where it is not practical to maintain a 10 foot (3.0m) separation, KDHE will consider proposals providing equivalent protection by other methods on a case-by-case basis, if supported by data from the design engineer. Equivalent protection may require sanitary sewer construction with one of the following additional protective features: concrete encasement, vacuum sewers, or jointless pipe such as polyethylene or cured-in-place.

When a water pipe and a sanitary sewer cross and the sewer is 2 feet (0.6m) or more (clear space) below the water pipe, no special requirements or limitations are provided herein. At all other crossings, the sanitary sewer is to be constructed of one of the following materials (or approved equal) and pressure tested to assure water tightness pursuant to Chapter VI of the KDHE Minimum Standards of Design of Water Pollution Control Facilities:.

Ductile iron pipe conforming to ASTM A536 or ANSI/AWWA C151/A21.51 with minimum thickness class 50, and gasketed, push-on, or mechanical joints in conformance with ANSI/AWWA C110/A21.10 or ANSI/AWWA C 111/A21.11.

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PVC pipe conforming to ASTM D3034 with minimum wall thickness of SDR41, ASTM F679, ASTM F789, or ASTM F794, with gasketed push-on joints in conformance with ASTM

D3212.

Reinforced concrete pipe conforming to ASTM C76 with gasketed joints in conformance with ASTM C361 or ASTM C443.

Joints in the sewer pipe shall be located as far as practical from the intersected water main.

Where a water main is laid across or through an area where there is an existing sanitary sewer, which is not constructed of one of the above specified materials and is 2 feet (0.6m) or less below the water pipe, the existing sewer shall be encased in concrete with a minimum of 6 in (15cm) thickness for a 10 foot (3.0m) distance on each side of the crossing or the crossed section of sewer replaced to meet the above specified construction requirements. KDHE will consider proposals providing equivalent protection by other means on a case-by-case basis, if supported by data from the design engineer.

2. Sewer Connections - There are to be no physical connections between any parts of the potable water system with building sewers, sanitary sewers, or wastewater treatment facilities by means of which it would be possible for sewage, even under exceptional circumstances, to reach the wells, storage reservoirs, or distribution systems.
3. Pressure Sewer Lines - When force mains run parallel to water lines, the separation distance shall be as far as practical, but at least a 10 foot (3.0m) horizontal separation shall be maintained. There shall be at least a two foot (0.6m) vertical separation at crossings with the water main crossing above the sewer force main. In cases where it is not practical to maintain the required vertical or horizontal 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.
4. Sewer Manholes - No water pipe shall pass through or come in contact with any part of a sewer manhole.
5. Storm Sewers - The separation distance between a storm sewer (which is not a combined storm/sanitary sewer) and a water main should be based on geotechnical considerations. Required separation distances between water mains and combined storm/sanitary sewers are equivalent to those for water mains and gravity sanitary sewers.
6. Drains - Underground drains from fire hydrants or valve pits should not be directly connected to sanitary or storm drains.

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B. Separation of Water Mains and Other Pollution Sources

It is of utmost importance that potable water lines be protected from any source of pollution. The following shall pertain to instances where septic tanks, absorption fields, waste stabilization ponds, feedlots, or other sources of pollution are encountered.

1. A minimum distance of 25 feet (7.6m) shall be maintained between all potable water lines

and all septic tanks or waste stabilization ponds.

2. Under no circumstances shall a water line extend through a septic tank absorption field or feedlot. All water lines shall be located a minimum of 25 feet (7.6m) from the farthest known extent of any sewage contamination. Under no condition will it be considered that encasement.

8. AS-BUILT DRAWINGS

Upon completion and acceptance of the project, prior to payment of the final estimate, the contractor will furnish the Engineer a complete set of dimensioned and annotated as-built drawings.

DETAILED CONSTRUCTION SPECIFICATIONS

**GENERAL
SECTION I**

A. GENERAL

The intent and purpose of these detailed specifications are to:

1. To specify materials and outline work procedures in the constructing of the sewers and manholes shown in the plans and listed in the proposal
2. Provide detailed construction specifications on all items of work when necessary to construct sewers, manholes and related items as listed in the proposal.
3. Establish the methods of measurements and payments.
4. Establish standards and methods of testing sewer pipe in-place.

B. CONTROL OF MATERIALS

The Engineer may obtain representative samples of all materials used in the construction at the site. The services of a testing laboratory may be used by the City to determine the conformity to these specifications.

Generally, the City shall control all sampling and testing. The cost of tests and laboratory service will be absorbed as listed in Technical Specifications.

Certifications may be requested on the following: Vitrified Clay Pipe, ABS Composition Pipe, Ductile Iron Pipe, PVC Pipe and Pre-Cast Concrete Manholes.

**SEWERS AND APPURTENANCES
SECTION II**

A. MATERIALS

1. General

a) Requirements

Unless otherwise specified, all material used in the work under this contract shall conform to the requirements of the current specifications or current methods of testing of the American Society for Testing Materials.

b) **Acceptance**

No materials shall be used on the work until accepted by the Engineer and all materials rejected by the Engineer as unsuitable or not in conformity with the plans or specifications or failing to pass the required tests shall be removed immediately from the work. Failure to condemn materials on preliminary inspection shall not be grounds for acceptance if future defects are found. The Engineer may obtain representative samples on materials used. The services of a testing laboratory may be used to determine conformity to these specifications.

2. **Vitrified Clay Sewer Pipe**

a) **Vitrified Clay Pipe** shall be furnished complete with all plugs, fittings, jointing materials, Class "C" bedding and other appurtenances required for installation.

b) **Class and Quality**

All vitrified sewer pipe shall be "ASTM Clay Sewer Pipe" designation C-700 except that where extra strength pipe is specified or required. The pipe shall be manufactured from surface clay, fire clay or shale, or a combination of these materials and shall be strong, durable, serviceable and free from objectionable defects.

c) **Workmanship and Finish**

Pipes shall be substantially free from fractures, large or deep cracks and blisters, laminations and surface roughness.

The glaze shall consist of a continuous layer of salt glaze, substantially free from large blisters or large pimples. No blisters shall exceed three inches (3") in diameter and no blisters or pimples shall project more than one-eighth (1/8) of an inch above the surrounding surface of the pipe for sizes up to and including eighteen (18") internal diameter. For sizes over eighteen (18") internal diameter, no blisters shall exceed in diameter more than two (2") inches per foot of the internal diameter of the pipe, nor project above the surrounding surface of the pipe more than one-eighth (1/8) of an inch per foot of the internal diameter of the pipe. Broken blisters shall be cause for rejection of the pipe

Not more than ten percent (10%) of the inner surface of any pipe barrel shall be bare of glaze except the socket, where it may be entirely absent. Glazing shall not be required on the outer surfaces of the barrel as the spigot and for a distance from the end of the pipe equal to the specified depth of socket. There shall be no well-defined network of glazing lines or hair cracks.

d) **Fitting and Jointing**

All fittings shall have a plain spigot end and a socket and corresponding in all respects with the dimensions specified for pipes of same internal diameter and fittings shall conform to the foregoing provisions for "Workmanship and Finish", Section 2(b). Curves shall be at angles of 90 degrees or 45 degrees as called for on the Plans. Jointing shall be of a resilient material recommended by manufacturer and meeting all requirements of ASTM C-700.

e) **Marking**

Each length of pipe over six inches (6") in diameter shall bear the initials or name of the person or company or corporation by whom manufactured and the location of the mill. The marking shall be indented on the exterior of the pipe near the socket and shall be plainly legible for the purposes of identification. All accepted pipe and fittings will be plainly marked by the Engineer's Inspector with regards to provisions for "Workmanship and Finish", Section 2(b).

f) **Inspection and Rejection**

All pipe shall be subject to inspection at the factory, trench or any other point of delivery by the Engineer or Inspector. The purpose of the inspection shall be to cull and reject pipes and fittings which, independent of the physical tests specified in the ASTM Standards, fail to conform to the requirements of these specifications.

Rejection

1. Blisters that are broken.
2. Insecure attachment of spurs on branches.
3. Failure to produce a clear ringing sound when hammer tapped for soundness.
4. Failure to develop 100% of the crushing strength requirements.
5. Chips or fractures on the interior of the pipe exceeding two inches in length, one inch in width and one-fourth the pipe shell thickness in depth.
6. Notches resulting from segments broken from outer edges of pipe sockets in excess of 50% of the socket depth.

3. **Ductile Iron Sewer Pipe and Fittings**

a) **General**

Ductile iron pipe shall be furnished complete with all plugs, glands, fittings, jointing materials, bolts, nuts and other necessary appurtenances required for installation.

b) **Class and Quality**

Ductile iron pipe shall be Class 52 conforming to ASTM A-377 of size and length shown on drawings. Any variation in metal strength shall be compensated for in metal thickness.

c) **Workmanship and Finish**

Flanged pipe may have integral or screwed on flanges with flanges faced and drilled per ANSA Spec. B 16.1, Class 125. Pipe buried or located outside structures may at the option of the Contractor be bell and spigot, standard mechanical joint or single gasket joint such as Fastite, Tyton, Belltite or approved equal. Standard tar coating inside and outside shall be provided.

d) **Fittings**

Underground or outside fittings may be bell and spigot or mechanical joint with flanged fittings inside structures. Fittings shall conform to ASTM A-377, Class 250 for 12" or smaller Class 150 for 14" and larger. Flanges shall be faced and drilled per ANSI Spec. B 16. 1, Class 125. Gaskets shall be neoprene or other synthetic rubber. Natural rubber will not be accepted.

e) **Handling**

All pipe, fitting and jointing materials shall be delivered sound and in conformity with these specifications. Pipes, Fittings and accessories shall be handled in a manner that will ensure a sound undamaged condition. Equipment, tools and methods used in unloading, reloading and hauling pipe and fitting shall be such that the pipe and fittings are not damaged. Hooks inserted in ends of pipe shall have broad, well padded contact surfaces. Defective linings and coatings may be repaired by and at the expense of the Contractor prior to acceptance of the pipe.

4. **Ductile Iron Pipe and Fittings**

a) **General**

Ductile iron pipe shall be furnished complete with all plugs, glands, fittings, jointing materials, bolts, nuts and other necessary appurtenances required for installation.

b) **Class and Quality** Ductile iron pipe shall conform to ANSI Spec. A21.5/AWWA Spec. C 150; ANSI Spec. A21.5 I/AWWA C 151 of size and thickness shown on drawings.

c) **Workmanship and Finish**

Exterior surfaces of pipe and fittings shall be shop coated with bituminous coating of manufacturer standard.

d) **Fittings**

All ductile iron pipe fitting shall conform to ANSI Spec A21.10/AWWA C 110, ANSI Spec A21.11/AWWA C 111 and shall be of the type indicated on the drawings. Gaskets shall be neoprene or other synthetic rubber. Natural rubber will not be acceptable.

e) **Handling**

All pipe fittings and joint materials shall be delivered sound and in conformity with these specifications in all respects. Pipe, fittings and accessories shall be handled in a manner that will ensure a sound, undamaged condition. Hooks inserted in ends of pipe shall have broad, well padded contact surfaces. Damaged coatings may be repaired by and at expense of contractor prior to acceptance of pipe and fittings.

5. **ABS Composite Pipe and Fittings**

a) **General**

ABS Composite Pipe shall be furnished complete with all plugs, fittings, jointing materials, Class "C" bedding and other appurtenances required for installation.

b) **Construction**

ABS Composite Pipe shall be manufactured in accordance with ASTM Designation D 2680-84. Pipe shall be mechanically extruded from virgin rigid ABS plastic in two (2) concentric tubes, integrally braced within the annulus and with the annular space filled

with Portland Cement perlite concrete or other inert filler material which shall fill the annulus to form the composite pipe. The above construction shall apply to all pipes eight inches (8") and larger.

c) **Fittings and Jointing Materials**

Service connections to the main shall be made using factory molded tee or wye connections. The jointing of ABS composite pipe shall be accomplished as a ASTM Designation D 2670-84, Type SC closure utilizing a solvent weld of a Methyl Ethyl Ketone (MEK) primer and a segment composed of (MEK) and a minimum of twenty percent (20%) by weight of dissolved ABS of the same type and grade as the pipe used. Manhole connections and waterstops and caps shall be of the type furnished by pipe manufacturer.

d) **Handling**

ABS Composite Pipe will be stored on a smooth bed to prevent point loading. Pipe will not be stacked over six feet (6') high. Pipe will not be dropped from the truck or dragged across sharp objects.

6. **Polyvinylchloride (PVC) Pipe and Fittings**

a) **General**

Polyvinylchloride pipe shall be furnished complete with all plugs, fittings, jointing materials, Class "C" bedding and all other appurtenances required for installation.

b) **Construction**

Pipe shall be white polyvinylchloride compound having a cell classification of 13364-A as defined in ASTM D-1784 and conforming to ASTM D-3034, SDR 35 except 4" pipe which shall be SDR 33.5. The ASTM Std. # ANSI/ASTM D 2321-74 shall be used in the underground installation of Flexible Thermoplastic Sewer Pipe (PVC).

c) **Workmanship**

Pipe and fittings shall be homogeneous throughout and free from visible cracks, holes, foreign inclusions and other injurious defects. Pipe and fittings shall be as uniform as commercial practical in color, opacity, density and other physical properties.

d) **Fitting and Jointing Materials**

Pipe joints shall be bell and spigot. Service connections to the main shall be made using factory molded tee or wye connection. Jointing materials for all connections shall be a high grade elastomeric compound either factory installed or field installed.

e) **Certification** A certification shall be submitted in accordance with ASTM D-3034, Section II.

7. **Bricks**

Bricks for masonry units shall conform to ASTM Specification C-32 Grade MA and shall be of uniform texture, hardburned throughout and free from lime, gypsum or other substances which would affect the brick under wet or freezing conditions.

8. **Mortar**

For laying bricks shall be composed of one (1) part cement and two (2) parts sand with approximately twenty pounds (20 lbs) of hydrated lime added for each sack of cement. All mortar constituents shall meet the following requirements.

Portland Cement shall conform to ASTM. Spec. C-150.

Lime shall conform to ASTM. Spec. C-5.

Sand shall conform to ASTM. Spec. C-44.

All materials for making mortar shall be approved by Engineer.

9. **Manholes**

Manholes, standard or drop, shall be constructed of the materials, size, form, thickness as shown on the Plans. Manholes may be cast-in-place, or pre-cast reinforced concrete or brick with a cast-in-place concrete foundation.

Openings in pre-cast reinforced concrete manholes shall be cast in the risers at the proper locations by the manufacturer. The Contractor shall submit shop drawings for each pre-cast manhole showing the make-up of sections and the location of all openings with respect to joints in the pre-cast units. Risers shall be selected to yield a maximum dimension between each opening and the nearest joint. Pre-cast units shall be free of fractures, large or deep cracks and surface roughness. The ends of manhole risers and tops shall be so formed that when assembled they will make a continuous and uniform manhole. The joints shall be of such design as will permit effective jointing to reduce

leakage and infiltration to the specified minimum and to permit placement

without irregularities in the wall surfaces of the manhole. Joints shall be sealed with a manufactured compound approved by the Engineer.

10. **Manhole Steps**

Manhole steps when required shall be placed as called out in the Plans and shall be made of tough gray pig iron conforming to ASTM Standard Specification A48 or approved corrosion resistance material.

11. **Castings and Covers**

Iron castings shall conform to the requirements of "Standard Specification for Gray-Iron Castings" of ASTM, Serial Designation A 48-48. Class 25 shall be required for all castings.

B. **CONSTRUCTION PROCEDURES**

1. **General**

These specifications will cover all work necessary for the construction of sanitary sewers, manholes and appurtenances thereto, including construction methods, clearing, excavation, subgrade, backfill, disposal of spoil, restoration together with other incidental work.

2. **Clearing and Grubbing**

a) **Clearing**

Contractor shall do all clearing necessary for the performance of the work preparatory to excavation work along the line of the proposed sewer and at the conclusion of the work he must leave the entire right-of-way in the same condition, insofar as possible, as it was when he commenced work. Clearing will include all trees along the line of the proposed sewer. All trees and shrubs designated by the Engineer to remain shall be carefully protected by the Contractor. All overhanging limbs of trees that interfere with construction shall be properly cut or trimmed and painted with an approved asphaltum base paint to the satisfaction of the Engineer.

b) **Grubbing**

Tree stumps resulting from clearing and tree removal operations that lie along line of proposed sewer or are within the limits of excavation will be removed. Main tree roots shall not be cut except where they fall within the area occupied by the pipe. Excavation shall be done by hand where necessary to prevent injury to roots or trees.

c) **Disposal of Debris**

Removed debris shall be disposed of by Contractor at his expense to a location suitable to the Engineer.

d) **Protection of Property and Utilities**

- 1) Contractor shall protect all trees, shrubbery, grapevines, floral beds, telephone or electric line poles, garages, houses or other structures encountered on or adjacent to the line of work and, in case of any damage or loss to such property due to his operations or negligence, he must completely satisfy the owner or owners thereof by replacing or restoring such damaged property so that its condition is at least equal to that found when work was started.
- 2) Waterlines, gas lines, wire lines, service connections, water and gas meter boxes, light standards, cable ways, signals and all other utility appurtenances within the limits of the proposed construction are to be moved by the owners or operations at their expense, except as otherwise provided for in the Special Provisions or noted on the Plans.
- 3) It is understood and agreed that the Contractor has considered in his bid all the permanent and temporary utility appurtenances in their present and relocated positions and that no additional compensation will be allowed for any delays, inconvenience or damage sustained by him due to any interference from said utility appurtenances.

3. **Excavation and Trenching**

a) **Rock Excavation.**

Rock excavation shall be classified as ledge or bed rock that can only be removed by ripping, jack hammering, drilling or blasting. The Engineer or Inspector with the Contractor's representative shall agree to rock elevations day by day and the Engineer's decision shall be final. Rock shall be removed to a depth of approximately six inches (6") below the bottom of the trench grade and brought to grade by refilled, tamped earth, 3/4" wet gravel or embedment material to bring the trench bottom to grade. After any rock is exposed, the Contractor shall notify the Engineer before removal in order that measurements can be taken.

b) **Trenching**

Trenches shall be excavated so that the bottom of the trench is on a true grade. Trenching may be done by any approved method but in any case the final grade

shall be obtained by hand shoveling the final three inches (3") of depth of the trench. In any case,

where in the opinion of the Engineer, the excavation is made to a greater depth than as specified, the Contractor shall thoroughly compact the earth refill by mechanical tampers.

Trench sides may be sloped from a point one foot above the top of the pipe to profile grade, however, Contractor shall keep all excess excavation within the right-of-way and be fully responsible for damages resulting therefrom. Only by permission of the Engineer may excess dirt be hauled from the job site.

Holes shall be dug just ahead of pipe laying operations to a depth below grade sufficient to receive the bells of the pipe.

Trenches shall be excavated in a width adequate for workmen but shall not be wider than the outside diameter of the pipe plus eighteen inches (18") at a point one foot above the top of the pipe.

c) **Tunneling**

Will be permitted under crosswalks and trees, provided such tunnels do not exceed eight feet (8') in length, and where the top of the tunnel arch is not less than six feet (6') below ground level. All other tunneling may be done only if shown on plans or then deemed necessary by the Engineer. All tunneling shall be true to specified line and grade.

d) **Disposal of Excess Excavated Materials**

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

4. **Manholes**

a) **General**

All manholes shall be constructed, complete with covers and ladder steps, in accordance with the details shown on the Plans. Standard manholes above the foundations, unless otherwise required by the Plans, shall be constructed of standard brick masonry or, at the option of the Contractor, of concrete or of pre-cast reinforced concrete units. Foundations for all manholes shall be cast in-place concrete. All sewers extending from manholes shall be supported with concrete to the first joint of the pipe from the manhole wall. When the vertical distance between inlet and outlet of the manhole exceeds twenty-four inches (24") a drop manhole, together with all fittings and appurtenances will be provided.

b) **Brick Manholes**

Brick for use in manholes less than sixteen feet (16') in depth shall be at least eight inches (8") thick for use in manholes sixteen feet (16') to thirty feet (30') in depth, the depth below sixteen feet (16') shall be at least twelve inches (12") thick.

All brick units shall be saturated with water before laying and shall be damp but free from surface water when laid.

All mortar shall be used within 40 minutes after mixing. Mortar which has begun to take on initial set shall be discarded and shall not be mixed with additional cement or new mortar. All brick manholes shall be plastered in a like manner with mortar not less than one inch (1") thick.

c) **Cast-in-Place Concrete Manholes**

1) **Base:** The base shall be cast monolithically with the rest of the manhole. The invert and flow channel shall be formed during or immediately after the placing of the concrete and brush-finished as soon as the concrete has sufficiently set. The concrete must set for 24 hours before any pipe inside of the manhole is trimmed.

The base concrete shall be 3,000 PSI, maximum slump four inches (4"), vibrated or tamped on undisturbed bearing.

The base shall have a minimum diameter eight inches (8") greater than the outside diameter of the manhole and a minimum thickness including the area under the pipe as follows:

0' to 8' Manhole	8 inches
8' to 12' Manhole	10 inches
12' and above	12 inches

- 2) **Manhole Barrel Section:** The vertical forms, wall spacers, steps and placing cone must be carefully positioned and firmly clamped in-place before any placement is made. The manhole shall be cast of 3,000 PSI concrete with a maximum slump of four inches (4"). The first placement shall consist of the base concrete deposited evenly around the walls. When this is complete and before additional concrete is added, the concrete must be carefully vibrated on each side of each pipe. Additional concrete must be deposited in evenly distributed layers of above eighteen inches (18") with each layer vibrated to bond it to the preceding layer. The wall spacers must be raised as the placements are made with the area from which the spacer is withdrawn being carefully vibrated.

Excessive vibration is to be avoided. A maximum of two percent (2%) calcium chloride may be added to the concrete, at the Contractor's option, to speed the set. The forms may be removed as soon as the concrete has sufficiently set, approximately 2 hours after placement for manholes on small diameter lines, and 6 hours after placement for manholes on large diameter pipe.

Form marks and offsets up to one inch (1") will be permitted on the outside surface of the manhole. Form marks and offsets up to 1/2 inch will be permitted inside of the manhole. All offsets on the inside surface of the manhole will be smoothed and plastered so there is no projection or irregularity capable of scratching a worker or catching and holding water or solid materials. Honeycomb will be plastered with a mortar consisting of three (3) parts of masonry sand to one (1) part Portland Cement immediately upon removal of the forms.

Wall thickness for 4'-0" diameter manholes shall be six inch (6") minimum for manholes 14'-0" deep or less; over 14'-0" deep, wall thickness shall be twelve inch (12") minimum. Wall thickness for 5'-0" and 6'-0" diameter manholes shall be eight inch (8") minimum for manholes 14'-0" deep or less; over 14'-0" deep, wall thickness shall be twelve inch (12") minimum.

- 3) **Cold Joints:** Should circumstances make a cold joint necessary, a formed groove or reinforcing dowels will be required in the top of the first placement for shear protection. Immediately before the second placement is made, the surface of the cold joint shall be thoroughly cleaned and wetted with a layer of mortar being deposited on the surface.

d) **Pre-cast Reinforced Concrete Manholes**

Pre-cast reinforced concrete manholes shall be constructed of pre-cast reinforced manhole sections conforming to the requirements of the specifications. Pre-cast reducer cone sections shall be of the eccentric type. All joints shall be set and sealed with an asbestos impregnated, cold applied roofing compound or with an approved rubber gasket. A twelve inch(12") to eighteen inch(18") adjusting ring shall be installed immediately below the cone section on all manholes with a depth greater than six feet (6') plus the outside diameter of the largest connecting pipe. The adjusting ring will not be required on manholes constructed in existing paved streets or in streets that will be paved as a part of the same contract. Manhole steps shall be grouted in the manhole sections with an expanding grout. The manhole ring shall be bolted to the pre-cast reinforced concrete manhole section on manholes whole exterior walls will be exposed to the weather.

e) **Inverts**

Manhole inverts shall be carefully constructed to maintain the proper velocities through the manhole and in no case shall the invert sections through the manhole be greater than that of the outgoing pipe. The shape of the invert shall conform exactly to the lower half of the pipe it connects. Where it is not practicable, due to breaks in grade or elevation of incoming sewers, to use split pipe through manholes, the sewer invert shall be made of concrete deposited between forms, or of brick on edge laid up in cement mortar. The shape of the invert shall exactly conform to the lower half of the pipe it connects. Side branch inverts shall be constructed with as large a radius of curvature as possible. Inverts, whether of concrete or brick, shall be plastered with cement mortar and left smooth and clean.

f) **Exterior Coatings**

The exterior surfaces of all concrete and pre-cast reinforced concrete manholes shall be treated with an application of hot liquid asphalt. The surface shall be thoroughly dry at the time of application and the air temperature shall be not less than 40 degrees F. The asphalt shall be applied at a rate of not less than six (6) gallons per one hundred (100) square feet. The asphalt coating shall thoroughly and uniformly cover the surfaces of the manhole. The asphalt material shall not be applied within one foot (1') of any openings in the manhole walls and shall be omitted from the bottom one foot (1') of the base of all pre-cast reinforced concrete manholes. Field application of waterproofing asphalt shall be made at these locations after manhole is set and in-place and before backfill is started.

The outside of brick manholes shall be plastered and troweled smooth with one inch (1") of mortar composed of one (1) part cement to two (2) parts sand.

g) **Drop Manhole**

Drop manholes shall be built in accordance with the Plans. All fittings, connections,, drops, concrete drop encasement and all other sewer pipe appurtenances built into walls shall be provided for drop manholes. Only manholes which required outside pipe and fittings to provide facilities for dropping the sewage into the incoming line outside of the manhole will be designated and paid for as drop manholes. Inside drop manholes where the incoming line discharges sewage directly into the manhole and which do not require special fittings such as tees and elbows, will be considered to be standard manholes and paid for as such.

h) **Castings**

All ladder steps which are shown on the Plans to be anchored into manhole walls, iron manhole rings and covers, and other iron castings, shall be made of gray iron conforming to the standard specifications as hereinbefore stipulated, shall be free from cracks, holes, swells and cold shuts and shall have a smooth and workmanlike finish. Castings shall conform in all dimensions to the details shown on the Plans unless otherwise approved by the Engineer, thoroughly cleaned and subjected to a hammer test.

i) **Connections to Existing Manholes**

On entering existing manholes, openings shall be made as shown on Plans. The Contractor shall exercise care to minimize the opening needed to enter the pipe, and the existing manhole or concrete structure shall not be cracked or damaged. If the existing structures are damaged in creating entrance holes, they shall be removed and shall be rebuilt at no additional cost to the owner. The wall of the existing manhole or structure shall be neatly patched around the pipe with a dry mixture of concrete and the inside surface shall be troweled smooth to blend into the adjacent wall surface.

The existing invert shall be removed or revised to shape the branch flow lines into the main on as large a radius of curvature as practicable. The revised invert shall be plastered, troweled and brushed to a smooth, clean surface.

j) **Stubs**

Stubs for future connections shall be provided in manhole where shown on Plans or as directed by the Engineer. Stubs shall be not less than 3'-0" nor more than 4'-0" long, shall terminate in a bell and plug, with suitable wood location markers.

k) **Adjusting Rings**

Adjusting (spacer) rings in 3", 4", 5" or 6" increments may be used to achieve final elevations to a maximum of sixteen inches (16"). If the vertical distance between top of manhole exceeds sixteen (16"), an additional barrel section will be added to the manhole.

5. **Sewer Pipe**

a) **Location and Grade of Sewers**

Sewers and structures appurtenant thereto shall be located as shown by the Plans and as staked or otherwise fixed by the Engineer. Laser Beam Equipment and Technology shall be used to lay sewer pipe to grade and align. Subject to field conditions and approval of the Engineer, the grade and alignment of each sewer may be determined and maintained by the use of a line parallel to the grade and line of the sewer, this line to be supported above the ground surface on batter boards spaced not to exceed thirty feet (30') apart and rigidly anchored to and supported by substantial posts. Not less than three (3) batter boards shall be installed and maintained in proper position at all times as a check on the accuracy of the grade line. The Engineer shall be immediately notified of any misalignment of batter boards set in accordance with the cuts or elevations furnished to the Contractor by the Engineer. The elevations of batter boards and the alignment of the grade line will be determined from the elevations and alignments of offset points located along the trench, except where established directly by means of surveying instruments.

b) **Sewer Pipe Installation**

Pipe laying shall commence at the lower end of the section and proceed upgrade. Pipe shall be laid so that the spigot end points in the direction of flow.

All sewer pipe shall be installed to exact line and grade and special care shall be taken to avoid disturbing line and grade of pipe already jointed and laid. All pipe shall be graded and bedded as hereinbefore provided. When pipe is installed and jointed in trench, it shall form a true and smooth line of sewer and pipes shall not be trimmed or cut except for closures. Any pipe not making a good fit shall be removed. Permissible defects as specified hereinbefore shall be placed in the top of the sewer or as otherwise directed by the Engineer. Pipe shall be kept in a clean condition before being installed in the trench and when installed shall have all interior surfaces of the pipe sockets and exterior surfaces of pipe joints clean and dry before any jointing is performed. When necessary in the opinion of the Engineer, a suitable swab or drag shall be pulled through each joint of pipe as it is laid and jointed. All sewers constructed under this Contract must be kept thoroughly clean. When the trench is left at night or the pipe laying stopped, the upper end of the pipe must be closed by using an end board closely fitting the socket end of the last pipe. This end board shall have several small holes bored near the center to prevent the trench filling with water and to keep out sand and earth from the sewer, but in no case shall the end board be inserted and water allowed to enter until the Engineer is satisfied that the sewer will not be injured by water coming into contact with the pipe joints, pipe backfill or subgrade.

c) **Pipe Joints**

- 1) **Vitrified Clay Pipe** shall be furnished with factory-molded joints. Pipe shall be handled, loaded, transported, stacked and laid in such manner that no weight, including the weight of the pipe itself, will bear on or be supported by the spigot rings at any time. Care shall be taken to avoid dragging the spigot ring on the ground or allowing it to come in contact with gravel, chat, crushed stone, rocks or other hard objects. Joint rings which have been damaged in any way will not be accepted and shall not be incorporated in the work. Vitrified clay pipe with the molded polyvinyl chloride coupling shall be connected by first brushing upon the matting surfers the proper lubricant sealer as recommended by the manufacturer. The spigot end shall be centered on grade into the bell end of the last downstream clay pipe length and shoved home and properly seated with the application of a moderate force by a pry or lever device. Pipe shall be joined no later than five (5) minutes after the application of the lubricant sealer. Prior to application of joint lubricant all joints shall be wiped thoroughly to remove all dust, grease or other objectionable material.

- 2) **Acrylonitrile-Butadiene-Styrene (ABS) Composite Pipe:** The joining surfaces of ABS pipe and fittings shall be free of dirt, grease or foreign matter. The joining surfaces shall then be thoroughly cleaned with a cleaner specified by the manufacturer of the pipe. After the surfaces have been cleaned, a heavy coat of solvent cement shall be applied to the joining surface of the pipe and a light coat of solvent cement shall be applied to the socket joining surface using a natural bristle brush. The pipe is then immediately inserted to the full socket depth while rotating the pipe or fitting one-quarter turn to ensure even distribution of the cement. Excess cement shall be wiped from the outside of the pipe at the shoulder of the fitting. Care shall be exercised to ensure that the pipe spigot is not turned in the socket during the wiping process. If a fillet or bead of cement is not visible after a joint is assembled, a heavier coat of solvent cement should be used on the pipe spigot.

No attempt shall be made to adjust the joint after the cement has set. The laying of ABS pipe shall not be permitted at temperatures below 32 degrees F.

- 3) **Ductile Iron and Ductile Iron Pipe:** Before jointing bell and spigot pipe, all lumps, blisters and excess coating materials shall be removed from the bell and spigot ends of the

pipe. All oil and grease shall be removed. The outside of the spigot and the inside of the bell shall be wire brushed and wiped clean and dry. Prior to installation of gasket, bell end will be brushed with a lubricant of manufacturer's recommendation. A clean gasket will be installed in the bell end ensuring a correct positioning. If a cut pipe is to be installed, the cut end will be smoothed and beveled with a portable grinder. Plain ends will be cleaned and lubricated prior to joining. Jointing will be done with straight alignment. For pipe jointing during cold weather, gaskets will be warmed prior to placing in bell. Care must be taken to ensure that the spigot end is firmly seated against shoulder of the bell.

- 4) **Polyvinylchloride (PVC) Pipe:** All joint preparation and jointing operations shall comply with instruction and recommendations of the manufacturer. Joining surfaces of pipe and fittings shall be free of dirt, grease and foreign matter. Immediately before joints are pushed together, all joint surfaces shall be coated with a lubricant furnished with the pipe. The position and condition of each elastomeric gasket (unbound) shall be checked with a feeler after the joint is completed.

d) **Tee Connections**

Tee Connections shall be located at the points shown on the Plans or designated by the Engineer. The Contractor shall be sure that tee connection locations have been marked in advance of the construction of any sewer serving any property which will require sewer service and, in case such locations have not been so designated, shall stop the sewer construction until the necessary tee connection location or locations have been obtained. Tee connections shall be so installed that the lower lip of the connection is not more than two inches (2") below the outside top of the pipe. All tee connections shall be cocked to a 45 degree angle to the plane of the sewer line. After installation, tee connections shall not be covered with backfill until determination and record has been made by the Engineer of the location of each with reference to the nearest manhole downstream therefrom, and the direction in which the tee faces. In addition, each tee connection shall be marked with a wooden strip extending from the tee vertically to within one foot of the ground surface. All such markers shall be securely anchored and maintained in a proper vertical position until backfilling has been completed. Tee connections shall be closed by means of suitable vitrified clay stoppers, pre-cast cement mortar discs, fitted with factory-molded joints or ductile iron stoppers of manufacturers recommendation. Stoppers shall be further sealed after installation with mastic joint filler.

e) **Bed and Cover**

Each section of sewer pipe in the trench shall rest upon the pipe bed for the full length of the pipe barrel. The bottom of the trench shall be free from rocks, clods, frozen chunks or other sharp-edged objects where pipe is being laid in a trench having a rock bottom below the bottom of pipe, six inches (6") of limestone dust or aggregate of a maximum size 3/4" diameter bedding material free of earth, shale or other impurities and this bedding material shall be prepared in the trench bottom before the pipe may be lowered into the trench. Granular fill should be placed to encompass sanitary sewer pipe with four inches (4") of gravel below pipe in earthen trenches and six inches (6") above pipe for both earthen and rock trenches. Granular fill to be crushed stone or pea gravel with not less than ninety-five percent (95%) passing 1/2" sieve and not less than ninety-five percent (95%) to be retained on #4 sieve, with not more than two percent (2%) passing the #200 sieve, to be placed in not more than six inch (6") layers and compacted in accordance with the specifications.

f) **Concrete Embedment and Encasement of Sewer Pipe**

Concrete embedment or encasement of sewer pipe shall be installed where and as shown by the Plans or as provided by any other Contract Document also where, in the opinion of the Engineer, such pipe reinforcement is necessary because of any unforeseen condition encountered in the work.

Concrete used in pipe embedment or encasement shall be furnished, placed and compacted in conformity with the SECTION: CONCRETE. Reinforcement steel shall be provided where and as required.

- 1) Each length of pipe shall be installed on a suitable block or other support located close to the pipe bell and the pipe brought to exact line and grade by means of wedges placed on each side of the pipe.
- 2) Each length of pipe shall be rigidly held in lateral alignment by means of either struts between the pipe barrel and the trench bank installed at the spring line or pipe launch, or by means of wedges placed beneath and on each side of the pipe after the top anchorage described in the following sub paragraph 3 is in-place.

Such lateral supports shall be installed immediately back of the bell of each pipe. All lateral bracing of the pipe shall be done prior to filling the pipe joints with the jointing material.

- 3) Each pipe shall be anchored, to prevent flotation by means of a vertical strut placed immediately back of each bell, such strut being securely attached to, or wedged beneath, a

cross brace or member preferably anchored to a horizontal plank on each side of the trench, although such struts may be wedged between vertical bracing planks. In any case, cleats shall be nailed across the tops of the cross member and into the side planks to properly resist upward thrust. The cross brace and side planks shall be kept above the top of the concrete fill with the bottom edges of the cross braces preferably at the top elevation of the concrete as a guide in the placement thereof to the proper thickness above the top of the pipe barrel.

- 4) Pipe joints shall be filled or otherwise sealed with the same materials and in the same manner as other joints in the same line of sewer.
- 5) All loose material shall be removed from the trench prior to placing any concrete therein. The concrete as installed shall have a continuous and uniform contact with undisturbed trench excavation material on both sides and the bottom of the trench 1) where side forms are indicated or permitted by the Plans or 2) where sheeting is left in-place in the trench, in which case the concrete is to be poured directly against the sheeting.

g) **Installation of Sewers in Pipe Encasements**

Sewers under railroads and highways shall be installed inside of corrugated metal pipe encasements of the diameters specified on the Plans placed by boring or jacking in accordance with the SECTION: EXCAVATING AND TRENCHING.

After installation of encasement pipe, ductile iron sewer pipe shall be installed on skids to line and grade in the encasement in accordance with details shown on the Plans. When the sewer is installed and one end of the encasement has been sealed around the sewer, as shown on the Plans, the void space in the encasement shall be completely backfilled by blowing sand into the encasement and around the sewer and the other end of the encasement shall then be sealed.

At locations where the ductile iron sewer pipe placed in the encasement joins vitrified clay pipe sewer at either end, a concrete collar shall be constructed around the joint between the two types of pipe. If working pits or shafts exceed the maximum allowable trench widths specified in the SECTION: EXCAVATING AND TRENCHING, concrete encasement or arch encasement shall be installed as directed by the Engineer.

h) **Sewers to be Kept Clean**

All sewers and drains must be kept thoroughly clean. When a connection has been made to an existing manhole, the downstream end of the newly constructed sewer shall be sealed so

that no water or dirt can enter the existing pipe. During construction the water level in any part of the newly constructed sewer system shall not be permitted to exceed three and one-half feet (3 1/2') in depth. The work area shall be dewatered for joint construction and compaction. Inappropriate bedding will be removed under the direction of the Engineer and replaced with approved backfill. Upon completion of the new construction work, all sewer pipes shall be thoroughly cleaned by contractor and accepted by the owner before a permanent connection is made by removing the seal.

6. **Backfill**

a) **General**

Backfilling will only be accomplished after pipelines, joints and bedding have been inspected and approved. Water settling of earth backfill will not be permitted. During progress of construction all ditches and trenches shall be properly maintained and regraded where necessary after rains to prevent insofar as possible any chance of injury or damage to persons or vehicles.

b) **Sewer Trenches**

- 1) **Compacted Backfill** the full depth of the trench above the embedment, will be required in streets, street right-of-ways, roads, highway shoulders, driveways and parking areas and under curbs, sidewalks and other surface construction.

The backfill shall be composed of selected excavated materials, finely divided and free from debris, junk, large clods, organic material and rocks larger than six inches (6") loose layers at optimum moisture content and mechanically compacted the full width of the trench to ninety percent (90%) of maximum density as determined in accordance with A.A.S.H.T.O.. Type AA-MR-90. The equipment used for the compaction shall not transmit damaging shocks to the pipe.

- 2) **Uncompacted Backfill:** Where compacted backfill has not been specified or shown on drawings, compaction will only be required to the extent necessary to prevent future

settlement.

Uncompacted backfill material need not be as carefully selected as materials for compacted backfills; however, the material should be free of brush and junk. Rocks and boulders larger than six inches (6") will not be permitted in the lower portion of the trench closer than two feet (2') to the top of the pipe, nor shall rocks or boulders be placed in the upper twelve inches (12") of the trench without the permission of the Engineer. Large stone may be placed in the remainder of the backfill only if well separated to prevent excessive voids in the backfill.

Uncompacted backfill may be placed by any method acceptable to the Engineer. The method used shall not permit damaging impact to the pipe nor impose excessive concentrated loads on the pipe.

- 3) **Unsuitable Compacted Backfill Material:** Rock and boulders larger than six inches (6"), debris and junk will not be permitted in the compacted backfill material and shall be removed and disposed of at designated disposal areas or as directed by the Engineer.
- 4) **Borrow:** Where approved excavated materials are not sufficient to complete the backfill, the Contractor shall complete the backfill with other approved borrow materials. Obtaining borrow materials shall be the responsibility of the Contractor and at no additional cost to the owner.
- 5) **Clean-Up** shall be an integral part of the work and shall be completed as soon as possible. Clean-up shall include restoration of the working area to a condition at least equal to that found at the beginning of construction.

c) **Tunnels**

Unless otherwise specified or shown on the Plans, backfill in tunnels may consist of either sand, earth or lime dust. Backfill shall be placed in a manner that will completely fill all voids between the tunnel and outside diameter of the pipe where placed against the bell. It shall be dense and firm. Adequate provision shall be made to prevent sand from slumping or running out of the ends of the tunnel.

d) **Manholes**

Backfilling for cast-in-place concrete manholes will be accomplished evenly and carefully around the manhole seventy-two (72) hours or more after placement of concrete is complete.

Other types of manholes will be backfilled in the same manner as prescribed for sewer trenches.

e) **Embankments Over Sewers**

At locations as shown on the Plans, the Contractor shall haul in earth materials and construct embankment to the line and grades as shown. Excess excavated materials from other locations on the project which are satisfactory to the Engineer may be used in these embankments or the Contractor may procure materials at convenient locations provided he makes satisfactory arrangements with the property owner where the material is obtained. If the Plans call for the embankment to be compacted, it shall be compacted as specified herein for trench backfill.

c. **Acceptance Tests - Main Lines and Manholes**

Each reach of sewer shall meet the requirements of the following acceptance tests. All defects shall be repaired to the satisfaction of the Engineer.

1. **Lamping**

Each section of sewer line between manholes shall be straight and uniformly graded. Each such section will be lamped by the Engineer. The Contractor shall furnish suitable assistance to help the Engineer.

2. **Exfiltration**

The Contractor shall conduct an exfiltration test on each reach of sewer between manholes. The first line between manholes shall be tested before backfilling and before any sewer pipe is installed in the remainder of the work. Thereafter, individual or multiple reaches may be tested at the option of the Contractor.

Exfiltration tests shall be conducted by blocking off all manhole openings except those connecting with the reach being tested, filling the line and measuring the water required to maintain a constant level in the manholes. Each manhole shall be subjected to at least one (1) exfiltration test.

During the exfiltration test, the average water depth above the pipe invert shall be ten feet (10'), unless manhole depths are such that this is impossible. The maximum depth at the lower end shall not exceed twenty-five (25') and the minimum depth at the upper end shall be at

least five feet (5') above the crown of the pipe.

Reaches of sewer in which sewer service lines are encountered between manholes shall be completed, including manholes and the exfiltration test acceptably complete, prior to connecting such service lines. Tee branches shall be plugged as specified herein, or may be fitted with a temporary vitrified clay pipe riser, extended above the gradient at which exfiltration testing will be done.

The total exfiltration shall not exceed 200 gallons per inch of nominal diameter per mile of pipe per day for each reach tested. For purposes of determining maximum allowable leakage, manholes shall be considered sections of forty-eight inch (48") pipe. The exfiltration tests shall be maintained on each reach for at least two (2) hours and as much longer as necessary, in the opinion of the Engineer, to locate all leaks. Manholes will be tested separately as described in Item C.7 - Acceptance Tests - Manholes described in these specifications.

The Contractor shall provide, at his own expense, all necessary piping between the reach to be tested and the source of water supply, together with equipment and materials required for the tests. The methods used and the time of conducting exfiltration tests shall be acceptable to the Engineer.

Should the pipe not withstand the hydrostatic test as outlined in these specifications, the Contractor shall be required to uncover, correct and backfill the pipe without cost to the City.

If the leakage in any reach exceeds the allowable maximum, it shall be retested after the leaks are repaired.

3. Air Testing

Air testing may be used in lieu of exfiltration testing for sewer pipe but not for manholes. Air testing shall comply with ASTM C828 for verified clay pipe (4" to 12" or ASTM F1417-92 for PVC pipe). Manholes shall be tested as noted in Item C.7 - Acceptance Tests - Manholes of these specifications. Procedures for air testing and manhole testing shall be submitted to the Engineer for review before testing is started.

Leaks shall be located by air testing short section of pipe. Leaks shall be repaired and the reach of sewer retested.

4. Infiltration

If, at any time prior to expiration of the guarantee period, infiltration exceeds 200 gallons per inch of nominal diameter per mile of sewer per day, the Contractor shall locate the leaks and

make repairs as necessary to control the infiltration.

5. **Deflection Tests**

Checks for excessive deflection will be tested on pipe by pulling through a mandrel or other methods acceptable to the Engineer. Pipe with diametrical deflection exceeding five percent (5%) of the inside diameter shall be uncovered and the bedding and backfill replaced to prevent excessive deflection. Repaired pipe shall be retested.

6. **TV Camera** The City Engineer will use TV camera to check all sewers in-place for quality.

7. **Acceptance Tests - Manholes** Testing of manholes shall be by a) or b).

a) **Exfiltration Testing**

Exfiltration testing with leakage less than 1.14 gallon/foot/day for all diameters of manholes. (Full depth of manhole or 25 feet; whichever is less.)

b) **Vacuum Testing**

The testing shall be done after assembly of the manhole. The manhole-to-pipe connection shall be as approved by the Engineer. All lift holes shall be plugged with a non-shrinking mortar, as approved by the Engineer. The seal between the manhole sections shall be in accordance with ASTM C923. The Contractor shall plug the pipe openings, taking care to securely brace the plugs and the pipe. Testing shall be as follows:

Draw a vacuum to 10" of Hg. in manhole and isolate manhole from vacuum pump.

The test shall pass if the vacuum remains at 10" Hg. or drops to 9" Hg. in a time greater than one minute. If the manhole fails the initial test, the Contractor shall locate the leak and make proper repairs. Leaks may be filled with a wet slurry of accepted quick setting material.

D. **Basis of Measurement and Payment**

1. **General**

All work performed under this section will be paid for at the lump sum of unit prices stated in the proposal of the accepted bidder. Unit price payment will be based on measurements of installed items as hereinafter described. Payment for unit price items and lump sum items shall constitute full compensation for all labor, materials, tools and equipment and incidentals required to complete work as described in accordance with plans and specifications. Any material, equipment or operation, required to complete the work, not specifically mentioned shall be considered incidental to the unit price pay items to which it pertains.

2. Clearing and Grubbing

- a) **Measurement:** No separate measurement will be made for clearing and grubbing except for the tree removal and stump removal that is listed as a separate pay item. Clearing and grubbing will include removal and disposal.
- b) **Payment** shall be made at the lump sum price on the bid schedule. Removal and disposal of brush, slash and debris shall be subsidiary to lump sum bid price.

3. Tree Removal and Stump Removal

- a) **Measurement:** If tree removal and stump removal are called for in bid schedule, measurement will be by number of trees and stumps specified forty (40") or greater in circumference measured twenty-four inches (24") above ground level for trees and forty inches (40") or greater in circumference measured twelve inches (12") above natural ground for stumps.
- b) **Payment** shall be at contract unit price for each tree removed. Stump removal and disposal of slash and debris shall be subsidiary to this unit price.

4. Trenching

- a) **Measurement:** Trench excavation will be measured by the lineal foot, to the nearest foot, from center to center of manholes, for the various width and depth of trenches. Depth of trench excavation will be measured from surface of the ground to the invert grade of the pipe line. No separate measurement will be made for backfill, compacted or uncompacted pipe embedment or disposal of excess material.

- b) **Payment** will be made at the contract unit price for each classification of trench depth completed and accepted, which price shall include all excavation, control of ground water, sheeting and bracing, pipe embedment, backfilling, compacting, finishing and clean-up for

sewers and manholes. No separate payment will be made for disposal of excess material.

5. **Rock Excavation**

- a) **Measurement:** Rock excavation shall be measured per cubic yard of material classified as rock in-place before removal, excavation not to exceed a depth of six inches (6") below the flow line of the pipe and the width not to exceed the outside diameter of the pipe plus twelve inches (12") or as otherwise shown or specified. Quantities to be based on a trench with vertical sides. Measurement at manholes shall be to a depth of six inches (6") below the invert of the manhole and to a width equal to the outside diameter of the manhole plus twelve inches (12").
- b) **Payment** will be made at contract unit price per cubic yard. Cost of additional or specialized equipment required for rock excavation shall be subsidiary to this price.

6. **Manholes**

- a) **Measurement:** Standard manhole, zero to six feet (0'-6') in depth will be measured as a complete unit in-place which shall include all castings, covers, fittings, adjusting rings, manhole steps and other appurtenances. Extra depth shall be measured as the difference between total depth of the manhole and the standard manhole depth of zero to six feet (0'-6'). Depth shall be measured from top of casting to manhole invert. Drop manholes shall be measured separate from but in identical fashion to standard manholes.
- b) **Payment** for standard manholes shall be made at contract unit price for complete unit in-place approved and accepted. Extra depth for standard and drop manholes shall be paid for as measured at the contract unit price. Drop manholes will be paid for separate from but in identical fashion to standard manholes at contract unit price. Concrete filler and concrete collars or encasement where sewer enters or leaves manhole shall be subsidiary to the unit price of the manhole unless specifically listed on the proposal as a separate bid item. All costs in connection with providing stubs will be paid for as a part of the unit price bid for manholes and will cover installation of plugs and location markers.

7. **Sewers**

- a) **Measurements:** Main sewers of all sizes will be measured on a horizontal plane after

installation, through all line manholes, to the center of new manholes and through the walls of structures and existing manholes at points of connection. Laterals or branch connections will be measured along the line of the pipe after installation from point of connection to the tee to plug ends.

- b) **Payment** will be made for linear feet of sewer, main branch or lateral line in-place approved and accepted at the contract unit price. Cost of plug and location markers for branches or laterals shall be subsidiary to the cost of the sewers.

8. **Tee Connections**

- a) **Measurement:** Tee connections will be measured by individual connection installed, inspected and approved.
- b) **Payment** shall be made for individual tee at connection to sewer pipe. If there are no laterals or branch lines required, the cost of the tee connection shall include the cost of the plug and location marker.

9. **Concrete Encasement**

- a) **Measurement:** Concrete encasement where required will be measured separate and apart from any concrete collar or encasement required where sewer enters or leaves manholes if beyond the first joint. Measurement shall be in cubic yards of concrete with no separate measurement for forming ties or reinforcing steel.
- b) **Payment** shall be made by cubic yard of concrete at contract unit price and shall include the cost of all labor, forming materials, finishing, curing and, if required, reinforcing steel.

10. **Corrugated Metal Pipe Encasement**

- a) **Measurement:** Where metal pipe encasement is required in connection with a railroad or major road crossing, each crossing will be measured for payment horizontal along the longitudinal center line of the corrugated metal pipe from end to end of the metal pipe.

- b) **Payment** will be made by linear foot at contract unit price. The unit price bid shall include all costs in connection with excavation, backfilling, tunneling, metal pipe, excess cost of installing the sewer pipe in metal encasement above the amount bid for pipe laid in open

trench, all skids, jointing materials, jacking pipe, jacking pits, stabilized sand filler, end closures and all other work for and in connection with metal pipe encasement, not paid for separately. If the length of metal pipe encasement is extended for Contractor's convenience, all additional lengths will be a subsidiary obligation as no extra payment will be made.

11. **Connections to Existing Manholes**

- a) **Measurement:** Connections to existing manhole will be measured by individual unit.
- b) **Payment** will be made at contract lump sum price and shall be full compensation for necessary cutting, shaping, plugging, reshaping of existing invert, diversion and maintenance of flow, completing the connection as required, and all other work not covered by separate pay item.

12. **Modifications of Existing Manholes**

- a) **Measurement:** Modifications to existing manholes as specified or called for on Plans will be measured as an individual lump sum unit.
- b) **Payment** will be made at the contract lump sum bid price. Such payment shall be full compensation for necessary cutting, shaping, plugging, reshaping of existing invert, diversion and maintenance of flow, completing the modifications as required and all other work not covered by separate pay item.

A. **GENERAL**

This work shall consist of furnishing commercial grade concrete mixture (air entrained) from a ready-mix plant approved by the Engineer and in placing this material in accordance with this specification and in conformity with lines, grades, thickness and typical cross-section shown on the drawings or established by the Engineer.

B. **MATERIALS**

The commercial grade concrete mix shall be approved by Engineer. This approval will in general be based upon the following conditions:

1. All material shall be those normally used for the production and sale of concrete in the vicinity of this project.
2. The mixture produced shall have a minimum cement content of six (6) sacks (564 lbs.) of cement per cubic yard of concrete and a maximum water cement ration of 6.25 gallons per sack of cement including free water in aggregates.
3. Type I Cement may be used unless designated otherwise on the Plans or by the Engineer.
4. No additives other than air entraining agent will be allowed unless specifically approved by the Engineer.

C. **BATCHING AND MIXING**

1. **Consistency**

The consistency of concrete shall be suitable for the placement conditions. Aggregates shall float uniformly throughout the mass and the concrete shall flow sluggishly when vibrated or spaded. The slump shall be kept uniform.

2. **Delivery Tickets**

A delivery ticket shall be prepared for each load of ready-mixed concrete. A copy of each ticket shall be handed to the Engineer by the truck operator at the time of delivery. Tickets shall show the quantity delivered, the amount of each material in the batch, the outdoor temperature in the shade, the time at which the cement was added and the numerical sequence of the delivery.

D. **PLACEMENT**

Concrete shall be conveyed to the point of final deposit by methods which will prevent the separation or loss of ingredients During and immediately after placement, concrete shall be

thoroughly compacted, worked around all reinforcements and embedments and worked into the comers of the forms. Concrete shall be compacted by immersion-type vibrators, vibrating screeds or other suitable mechanical compaction equipment.

E. **TESTING**

An air content test shall be made from one of the first three (3) batches mixed each day. The Contractor shall provide all equipment and supplies necessary for the testing.

F. **REINFORCEMENT**

Reinforcements shall be of size and type shown on drawings; shall be accurately formed and positioned and shall be maintained in proper position while the concrete is being placed and compacted.

G. **FORMS**

Forms shall be designed to produce hardened concrete having the shape, lines and dimensions shown on the drawings. Forms shall be substantial and sufficiently tight to prevent leakage of mortar and shall be maintained in proper position and accurate alignment. Forms shall be thoroughly cleaned and oiled before concrete is placed. Where concrete is placed against gravel or crushed rock which does not contain at least twenty-five percent (25%) material passing a No. 4 sieve, such surfaces shall be covered with polyethylene film to protect the concrete from loss of water. Joints in the film shall be lapped at least four inches (4").

1. **Form Ties**

Form ties shall be of the removable end, permanently embedded body type and shall have sufficient strength and rigidity to support and maintain the form in proper position and alignment without the use of auxiliary spreaders.

2. **Edges and Corners**

Chamfer strips shall be placed in forms to bevel all salient edges and comers except the top edges of walls and slabs which are to be tooled and edges which are to be buried. Unless otherwise noted, bevels shall be 3/4 inch wide.

3. **Form Removal**

Forms shall not be removed or disturbed until the concrete has attained sufficient strength to safely support all dead and live loads. Care shall be taken in form removal to avoid surface gouging, comer or edge breakage and other damage to the concrete.

H. **FINISHING**

Recesses from form ties shall be filled flush with mortar. Fins and other surface projections shall

be removed from all formed surfaces except exterior surfaces that will be in contact with earth backfill.

I. CURING

Concrete shall be protected from loss of moisture by water saturation or membrane curing for at least seven (7) days after placement. Water saturation of concrete surfaces shall begin as quickly as possible after initial set of the concrete. Unformed surfaces shall be covered with polyethylene film, tarpaulins or sand to retain the water. Water shall be applied as often as necessary to keep the concrete saturated for the entire curing period. Chlorinated rubber type membrane curing compound may be used in lieu of water curing on concrete which will not be covered later with mortar or additional concrete. Membrane curing compound shall be spray applied at a coverage of not more than 300 square feet per gallon. Unformed surfaces shall be covered with curing compound within thirty (30) minutes after final finishing. If forms are removed before the end of the specified curing period, curing compound shall be immediately applied to the formed surfaces before they dry out. Curing compound shall be suitably protected against abrasion during the curing period. Concrete shall be protected against freezing for at least seven (7) days after placement.

J. REPAIRING DEFECTIVE CONCRETE

Defects in concrete surfaces shall be repaired to the satisfaction of the Engineer. All concrete which is honey-combed or otherwise defective shall be cut out and removed to sound concrete, with edges square cut to avoid feathering.

Concrete repair work shall conform to Chapter 9 of ACI 301 and shall be performed in a manner that will not interfere with thorough curing of surrounding concrete. Repair work shall be adequately cured.

K. MEASUREMENT AND PAYMENT

1. Concrete

Measurement and payment will be for completed and accepted work at the contract unit bid price. No separate payment will be for forming, finishing or curing. All material and labor required to produce the finished product will be included in the unit bid price.

2. Reinforcing Steel

Measurement and payment will be for completed and accepted work at the contract unit bid price.

A. **GENERAL**

This section covers miscellaneous items of work not covered elsewhere in the specifications.

B. **PAVEMENT REPLACEMENT**

Asphaltic pavement removed in the construction of the sewer pipe line and work appurtenant thereto, as indicated on the drawings, shall be replaced in accordance with the Kansas State Highway Commission Standard Specifications.

1. **Materials**

Stabilized Aggregate Base	Section J3-3, Type AB-3 Aggregate
Asphaltic Concrete Base Course	Section J2 and containing four-six percent (4%-6%) asphalt cement by weight
Bituminous Prime Coat	Section K I, Mc-1 or Mc-2
Asphaltic Concrete Surface Course	Section E-11, Class F

2. **Construction**

Stabilized Aggregate Base	Section D-2 Subgrade to bottom of asphalt
Asphaltic Concrete Base Course	Section D-9, six inches (6") thick placed on top of stabilized aggregate course
Prime Coat for Asphaltic Concrete	Section E-5, applied over base course at a rate of 0.25 gallons per square yard.
Asphaltic Concrete Surface Course	Section E- I 1, two inch (2") single course.

3. **Measurement and Payment**

Measurement and payment for asphaltic pavement of type specified on drawings will be in square yards. Payment will be at the contract unit bid price per square yard. No separate

measurement or payment will be made for pavement removal. This item will be subsidiary to pavement replacement.

C. **REMOVAL AND REPLACEMENT OF GUARD RAIL**

1. **General**

Guard rail shall be carefully disassembled, posts shall be dug out or pulled in a manner to prevent injury. Material shall be stored in neat piles at an accessible location and shall remain the property of the City. Contractor shall be responsible for all materials and shall replace at his own expense any material lost or damaged during removal, storage or reconstruction.

2. **Measure and Payment**

Measurement and payment shall be at the contract lump sum bid price for completed and accepted work.

D. **CRUSHED ROCK SURFACING**

1. **General**

Where the surfacing of existing gravel streets, driveways or travelways have been disturbed by construction, or construction equipment, the Contractor shall resurface the disturbed surface area at a rate of 225 pounds of crushed rock per square yard over the disturbed area or as indicated on the drawings. Surfacing material shall meet the following gradation requirements:

<u>Total Percent Retained on Standard Mesh Sieve</u>	
1 1/2"	0%
1"	0 - 30%
3/4"	10 - 40%
3/8"	25 - 55%
No. 4	40 - 70%
No. 10	55 - 85%
No. 40	75 - 95%
No. 200	88 - 97%
Plasticity Index	0 - 5

Surfacing material shall be spread and rolled with pneumatic rolling equipment, with water being applied as needed, until a dense and tight surface is obtained.

E. **SEEDING AND FERTILIZING**

1. **General**

All unpaved areas, consisting of lawns with established and maintained stands of grass, within the construction limits shall be seeded and fertilized upon completion of construction. Mulching, if specified, may be deleted at the request of the property owner, with the consent of the Engineer but no adjustment to the bid price for seeding and fertilizing will be made for such deletion. Hydraulic slurring method of seeding will be permitted, if chosen by the Contractor, provided the other requirements of this section are met.

2. **Seeds**

Seeds shall comply with the requirements of the latest edition of the "Standard Specifications for State Road and Bridge Construction", Kansas Department of Transportation and shall be of the kind of mixture of seeds specified in the Standard Technical Specifications, Plans and/or Special Conditions. Seeds shall be free of prohibited weed seeds and shall not have more than one percent (1%) of noxious weed seed. Seeds shall be delivered to the site in convenient containers, each fully labeled, bearing the name, trade name or trademark and warranty of the producer and a certificate of the percentage of the purity and germination of each kind of seed specified.

3. **Fertilizing**

Fertilizing shall be inorganic 12-24-12 grade, uniform in composition, free flowing and suitable for application with approved equipment. The fertilizer shall be delivered to the site in convenient containers, each full labeled, bearing the name, trade name or trademark and a warranty of the producer.

4. **Equipment**

The seeding operation shall be accomplished with equipment suitable for preparing the seed bed, sowing the seed and fertilizer in accordance with the applicable requirements of this specification.

5. **Preparation of the Seed Bed**

Areas to be seeded shall be cleared and graded as required preparatory to tilling the surface where top soil has been removed by construction, the Engineer may specify that a maximum of six inches (6") of top soil be placed prior to seeding. The surface to be seeded shall be free of all large stones, trash and large lumps of earth. The minimum depth of soil preparation shall be two inches (2").

6. **Application of Fertilizer**

Following the proper tilling of the soil, the fertilizer shall be distributed uniformly at the rate of

three hundred pounds (300 lbs.) per acre (approximately 0.06 pounds per square yard) and incorporated into the soil to a depth of at least two inches (2") by discing, harrowing or drilling methods.

7. **Planting Seeds**

All seeding work shall be done between the dates of February 15 and March 31 for Spring planting or August 15 and September 30 for Fall planting. Sowing shall be accomplished by use of an approved mechanical seeder or drill, making sure that successive seed strips overlap to provide uniform coverage. The kind of seed shall be as specified below, unless otherwise specified on the Plans or in the Special Conditions.

Seed Type and Rate of Application

<u>Type</u>	<u>Rate of Application</u>	
	<u>lbs/AC</u>	<u>lbs/S.Y.</u>
Kentucky Blue Grass Seed	20	0.004
Fescue K-31 Grass Seed	15	0.003
Domestic Rye Grass Seed	10	0.002
White Dutch Clover Seed	10	0.002

8. **Compaction**

Immediately following the completion of seeding operations, the entire area shall be compacted with a roller weighing not less than sixty pounds (60 lbs) but not more than ninety pounds (90 lbs.) per lineal foot of roller.

Mulching

Mulching, where required, shall be performed in accordance with the applicable portions of the latest edition of the "Standard Specifications for State road and Bridge Construction", Kansas Department of Transportation. Acceptable materials shall include straw and prairie hay and shall meet the approval of the Engineer.

10. **Watering**

Immediately following compaction and/or mulching where required, the seeded area shall be watered in sufficient amount to penetrate the seed bed to a depth of at least two inches (2").

Watering shall be performed in a manner not to cause erosion or damage to the seeded surface and shall be repeated daily for a period of fifteen (15) days after seeding, except when thoroughly wetted by rain.

11. **Protection and Repair**

If at any time before acceptance of the completed contract, any portion of the seeded surface becomes gullied or otherwise damaged or eroded, or the seeding has been damaged or destroyed, the affected portion shall be repaired to re-establish the specified condition prior to the acceptance of the work.

12. **Measurement and Payment**

Measurement for seeded area shall be by the square yard. Payment shall be by the square yard at the contract unit price. This price will include all labor, materials, tools, equipment and other incidentals necessary to complete the work.