

817 - STORM SEWERS

817.1 DESCRIPTION

All storm sewers, structures and appurtenances shall be located as shown on the plans and as determined by the Engineer.

817.2 MATERIALS

a. Concrete Pipe

(1) Pipe

Except as modified or otherwise provided in this chapter, the manufacture of concrete pipe shall be governed by ASTM C-76, ASTM C-506 and ASTM C-507. Except for fittings and closure pieces, each piece of the pipe shall not be less than eight feet long for pipe diameters 48 inches or less and shall not be less than six feet long for pipe diameters larger than 48 inches.

The wall thickness of concrete pipe shall be not less than Wall B.

The pipe class in each case shall be as designated on the plans, and shall not be less than Class III.

(2) Reinforcement

Circumferential reinforcement shall be full-circle type. Elliptical or part-circle reinforcement will not be approved. All reinforcing shall be located and spaced as recommended by the pipe manufacturers.

(3) Joints

Rubber gasket joints shall be required for all round pipe. Mastic joints shall be required for all other pipe shapes.

The City Engineer reserves the right to require joint testing on pipe sections, either at the plant or in place, as designated by the City Engineer to demonstrate compliance.

(4) Rubber Gasket Joints

Rubber gasket joints shall conform to ASTM C 1628-06 with the following additions and exceptions:

(a) Replace ASTM C 1628-06 5.1.1 with: Circular Cross-Section or "O-Ring" Gaskets for standard use shall meet Class A requirements. Non-Circular Cross-Section or "Profile" Gaskets for standard use shall meet Class E requirements.

(b) Replace ASTM C 1628-06 9.4 with: The manufacturer shall conduct concurrently the hydrostatic test described in 9.2 and the structural test described in 9.3. If proven watertight under these combined conditions, hairline cracks that do not leak shall not be cause for rejection. A vacuum test, run in accordance with the current written plant certification procedures of the American Concrete Pipe Association, may be used in lieu of the hydrostatic test referenced above.

(c) Joint design details shall be submitted for approval together with design data and test results verifying the adequacy of the joint design.

(5) Fine aggregate shall consist of clean natural sand conforming to ASTM C-33. Artificial or manufactured sand will not be approved.

(6) Lift Holes

Lift holes are prohibited for all concrete storm sewer pipes.

(7) No concrete pipe shall be delivered to the site of the work until concrete control cylinders representing such pipe shall have attained a compressive strength of at least 80% of the specified minimum 28 day strength.

b. Corrugated Metal Pipe

(1) All corrugated metal pipe shall be fabricated from galvanized iron corrugated metal sheets, aramid polymeric fiber bonded on both sides and bituminous coated. The U.S. Gauge number shall, in each case, be as designated on the plans, and as recommended by the manufacturer of the pipe for the depth of installation and classification of soil.

(2) The aramid polymeric fiber mat shall be embedded in the zinc on both sides of the metal sheets at the time of galvanizing and before the zinc has solidified. All work shall conform to

AASHTO M-36 for base metal and galvanizing and to AASHTO M-190 for bituminous coating. All joints in corrugated metal pipe shall be made using watertight coupling bands, not less than twelve inches wide, fabricated from the same material as the pipe and coated in the same manner. Each coupling band shall be lubricated sufficiently to insure that the corrugation of the band seats into the corrugations of the two pipes being joined, when the bolts are tightened.

(3) Corrugated Metal Pipe manufacturer's certification shall be submitted to the City Engineer.

c. Concrete Lined Ditch

Concrete shall be as specified in "Concrete Construction". Wire fabric shall conform to ASTM A-185. Wire fabric shall be supplied in flat sheet form.

d. Embedment

Embedment materials both below and above the bottom of the pipe, the classes of embedment to be used, and the placement and compaction of embedment materials shall conform to the requirements shown in the current Standard Details and to the supplementary requirements in this section.

e. Tamped Backfill

All backfill materials shall be in conformance with the City's Manual of Infrastructure Standards for Right of Way Restoration as promulgated by the City Engineer.

f. Special Pipe

All special pipe sections necessary to complete the storm sewer system as shown on the plans shall be furnished by the Contractor. These sections shall include, but not be limited to, drop joint or radius pipe, bends, tees, and Type III end sections. The pipe manufacturer shall provide shop drawings indicating the exact methods to be used to achieve the lines and grades indicated on the plans, including a pipe laying schedule, and the configuration and number of any special pipe sections. All special pipe sections used shall be subsidiary to other bid items.

817.3 CONSTRUCTION REQUIREMENTS

a. Location and Grade of Sewers

The grade and alignment of the pipe shall be determined and maintained from tacked offset stakes located alongside the trench upon which cuts and elevations have been established by the Contractor. Pipe alignment during construction shall be maintained by the use of laser alignment equipment. A minimum of eighteen inches of cover shall be maintained over the storm sewer pipe.

b. Post Construction Video

Once installation and backfill of the proposed storm sewer has been completed and all grading over and around the storm sewer is completed, the Contractor shall be responsible for video taping each run of storm sewer pipe, less than 60 inches in diameter, to verify that the segment of pipe is in sound, stable condition and that no failures have occurred during construction. The storm sewer system as well as it's upstream and downstream structures shall be carefully inspected to determine alignment, grade variations, separated joints, location and extent of any deterioration, breaks, obstacles, obstructions and debris, structure connections, inlet frames and structure walls and floors. The video shall be accompanied by a report to include photographs and a narrative documenting the condition of the pipe and adjoining structures and shall reference the storm sewer profile stationing of the approved final plans. For publicly funded construction, this video shall be delivered to the City Engineer for approval prior to any permanent pavement being placed over any said storm sewer. The development and delivery of this video shall be considered subsidiary to other bid items. For privately funded construction, the video and accompanying report shall be delivered to the City Engineer prior to commencing the 2-year contractor maintenance period.

c. 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. He shall be responsible for all damage caused by his blasting operations. All blasting within the City shall conform to City Ordinance Chapter 5.36 for Explosive and Blasting Agents.

Suitable weighted plank coverings or mattresses where required 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 backfill or embankment materials except as specified or directed.

d. Unauthorized Excavation

Except where otherwise authorized, shown or specified, all material excavated below the bottom of concrete walls, footings, slabs on grade, and foundations shall be replaced by and at the expense of the contractor, with concrete placed at the same time and monolithic with the concrete above.

e. Removal of Water

The contractor shall provide and maintain adequate dewatering equipment to remove and dispose of all surface and ground water entering excavations, trenches, or other parts of the work. Each excavation shall be kept dry during subgrade preparation and continually thereafter until the structure to be built, or the pipe to be installed, therein is completed to the extent that no damage from hydrostatic pressure, flotation, or other causes will result.

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

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

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

f. Sheeting and Shoring

Except where banks are cut back on a stable slope, excavation for structures and trenches shall be properly and substantially sheeted, braced, and shored, as necessary, to prevent caving or sliding, to provide protection for the workmen and the work, and to provide protection for existing structures and facilities. Sheeting, bracing and shoring shall be designed and built to withstand all loads that might be caused by earth movement or pressure, and shall be rigid, maintaining shape and position under all circumstances. The contractor shall brace and shore all trenches in full accordance with Occupational Safety and Health Standards - Excavations; Final Rule 29 CFR Part 1926.

g. Stabilization

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

Trench bottoms or subgrades for concrete structures which are otherwise solid, but which become mucky on top due to construction operations, shall be reinforced with one or more layers of crushed stone or gravel. Not more than one-half inch depth of mud or muck shall be allowed to remain on stabilized trench bottoms when the pipe bedding material is placed thereon. The finished elevation of stabilized subgrades for concrete structures shall not be above the subgrade elevations shown on the plans.

h. Crushed Rock or Gravel Fills

Crushed rock or gravel fills shall be placed on a suitably prepared subgrade and tamped to the extent necessary for consolidation. Crushed rock or gravel shall be free from dust, clay, or trash and shall be graded one and one-half inches to No. 4 as defined in ASTM C 33-05.

Where crushed rock or gravel fills are to be covered with concrete after the fills have been installed, the top surface thereof shall be graded to the required subgrade surface and covered with polyethylene film.

i. Trench Excavation

The contractor shall not open more trench in advance of pipe laying than is necessary to expedite the work. One block or 400 feet (whichever is the shorter) shall be the maximum length of open trench permitted on any line under construction. Except where tunneling is shown on the plans or is permitted by the City Engineer, all trench excavation shall be open cut from the surface.

j. Alignment, Grade and Minimum Cover

The alignment and grade or elevation of each pipeline shall be fixed and determined by means of offset stakes. An approved laser beam may be used in addition to offset stakes. Vertical and horizontal alignment of pipes, and the maximum joint deflection used in connection therewith, shall be in conformity with the requirements of the specification covering the installation of the pipe being laid in each case.

Where pipe grades or elevations are not definitely fixed by the contract drawings, trenches shall be excavated to a depth sufficient to provide a minimum depth of backfill cover over the top of the pipe of eighteen inches.

k. Limiting Trench Widths and Pipe Clearances

Trenches shall be excavated to a width which will provide adequate working space and pipe clearances for proper pipe installation, jointing, and embedment. However, the limiting trench widths below an elevation six inches above the top of the installed pipe, and minimum permissible clearances between the installed pipe and either trench wall, shall be as shown in the current Standard Details.

The stipulated minimum clearances shown in the table are not minimum average clearances, but are minimum clear distances which will be permitted between any part of the pipe as laid and any part, projection or point of rock, shale, stone or boulder.

Where necessary to reduce the earth load on trench banks to prevent sliding and caving, the banks may be cut back on slopes which shall not extend lower than one foot above the top of the pipe.

l. Unauthorized Trench Widths

Where for any reason, the width of the lower portion of the trench as excavated at any point exceeds the maximum permitted either pipe of adequate strength, special pipe embedment, or arch concrete encasement, as required by loading conditions and as determined by the City Engineer, shall be furnished and installed.

m. Mechanical Excavation

The use of mechanical equipment will not be permitted in locations where its operations would cause damage to trees, buildings, or other existing property, utilities, or structures above or below ground; in all such locations, hand-excavating tools and methods shall be used.

Mechanical equipment used for trench excavation shall be of a type, design, and construction, and shall be so operated that the rough trench excavation bottom elevation can be controlled, that uniform trench widths and vertical side walls are obtained at least from an elevation one foot above the top of the installed pipe to the bottom of the trench, and that the trench alignment is such that the pipe when accurately laid to specified alignment, will be centered in the trench with adequate clearance between the pipe and side walls of the trench. Undercutting of the trench sidewall to obtain clearance will not be permitted.

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

n. Excavation Below Pipe Subgrade

Except where otherwise required, pipe trenches shall be excavated below pipe subgrade elevations, as shown in the current Standard Details on file in the office of the City Engineer, to provide for the installation of granular foundation material.

o. Artificial Foundations in Trenches

Whenever so ordered by the City Engineer, the contractor shall excavate to such depth below grade as the City Engineer may direct, and the trench bottom shall be brought to grade with such materials as the City Engineer may order installed. All timber, concrete foundations, wooden invert, pipes, posts, stringers, and/or saddles, made necessary by quicksand or other treacherous soil, shall be installed as directed by the City Engineer.

p. Bell Holes

Bell holes shall provide adequate clearance for the tools and methods used in installing the pipe. No part of any bell or coupling shall be in contact with the trench bottom, trench walls, or the granular fill when the pipe is jointed.

q. Placement and Compaction

All granular fill material beneath the pipe shall be spread and the surface graded to provide a uniform and continuous support beneath the pipe at all points between bell holes or pipe joints. It will be permissible to slightly disturb the finished subgrade surface by the withdrawal of pipe slings or other lifting tackle.

After each pipe has been graded, aligned, placed in final position on the bedding material, and shoved home, sufficient pipe embedment material shall be deposited and compacted under and around each side of the pipe and back of the bell or end thereof to firmly hold and maintain the pipe in proper position and alignment during subsequent pipe jointing, embedment, and backfilling operations.

Embedment material shall be deposited and compacted uniformly and simultaneously on each side of the pipe to prevent lateral displacement of the pipe. Tamped backfill materials shall be placed in uniform layers and shall have a moisture content ensuring that the maximum density will be obtained with the compaction method used.

r. Trench Backfill

All trench backfill above pipe embedment shall conform to the following requirements.

(1) Tamped Backfill

Tamped Backfill is only allowable within unpaved areas of the ROW. It may also be used outside of the ROW and when backfilling Sanitary Sewer installations.

Materials for tamped backfill and the method of placement and compaction thereof shall be as specified for tamped backfill for pipe embedment, Subsection Tamped Backfill.

(2) Flowable Fill

Flowable Fill is required within all paved portions of the ROW including future paving, if they are known, per the Manual for Infrastructure Standards For Right of Way Restoration and City of Overland Park Standard Details.

(3) Structure Backfill

Backfill around structures shall be compacted, to the extent necessary to prevent future settlement, by tamping, placement of flowable fill, or other means approved by the City Engineer. Flowable fill is required around all structures within paved portions of the ROW including future paving, if they are known.

Material for backfill shall be as specified in this Chapter, Section Materials. and shall contain no wood, grass, roots, broken concrete, stones, trash, or debris of any kind. No tamped or otherwise mechanically compacted backfill shall be deposited or compacted in water.

s. Drainage Maintenance

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

t. Protection of Trench – Backfill in Drainage Courses

Where trenches are constructed in or across roadway ditches or other watercourses, the backfill shall be protected from surface erosion by adequate means. Where the grade of the ditch exceeds one percent, suitable ditch checks as approved by the City Engineer shall be installed as directed. Ditch checks may be creosote lumber, stone, or concrete as authorized. In any case, the ditch check shall extend not less than two feet below the original ditch or watercourse bottom for the full bottom width and not less than 18 inches into the side slopes thereof.

u. Disposal of Excess Excavated Materials

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

Excess earth from excavations located in unimproved property shall be distributed directly over the pipe trench and within the pipe line right-of-way to a maximum depth of six inches above the original ground surface elevation at and across the trench, and sloping uniformly each way therefrom. Material thus wasted shall be carefully finished with a drag, blade machine, or other suitable tool to a smooth uniform surface without obstructing drainage at any point. Wasting of excess excavated material in the above manner will not be permitted where the line of trench crosses or is within a railroad, public road, or highway right-of-way.

v. Maximum Trench Widths

Plans or specifications submitted to the City Engineer for approval shall show the maximum trench width for the sizes and classes of pipe at the various cover depths for the particular project.

w. Settlement

Whenever trenches or other excavations made by the Contractor in the performance of the work have not been properly filled, or where settlement has occurred at any time prior to final acceptance of the entire public improvement project, to the extent that the top of the backfill is below the original ground surface, such trenches shall be refilled and the surface compacted and smoothed to conform to the elevations of the adjacent ground surface. All sod in lawns and parks removed or damaged by reason of such settlement, and the repair thereof shall be restored to their original conditions.

x. Concrete Pipe

(1) Rubber Gasket Joints

Non-Circular Cross-Section or "Profile" Gaskets shall be installed in strict accordance with the pipe and gasket manufacturer's recommendations.

For Circular Cross-Section or "O-Ring" Gaskets, immediately before jointing the pipe, the outside of the spigot and gasket and the inside of the receiving bell shall be thoroughly cleaned and coated with a suitable lubricant. The position and conditions of the rubber gasket shall be checked with a feeler gauge after the piping unit is installed.

(2) Mastic Joints

Mastic joints will be required for all non-round pipe shapes. Mastic joints shall be constructed to attain a watertight joint. Sufficient mastic will be applied so as to completely fill any space between the spigot end of one pipe and the bell end of the adjoining pipe.

(3) Marking

Each pipe, fitting, or special section shall have plainly and permanently marked thereon:

- (a) Pipe class;
- (b) Date of manufacture;
- (c) Manufacturer's name or trademark;
- (d) On mitered pipe, amount of miter and point of maximum miter.

Markings shall be indented in the pipe or painted thereon with waterproof paint. Each end of each mitered pipe, fitting or special section shall be marked with a stripe of paint approximately one and one-half inches wide and two feet long, applied along the top center line.

(4) Joint Openings

Round pipe shall have rubber gasketed joints in accordance with ASTM C 1628-06 with noted exceptions above in this Chapter, Subsection Rubber Gasket Joints. Other shapes shall use mastic joints as follows. In laying pipe, the maximum mastic joint opening shall not exceed the manufacturers' recommendations, or the following table, which ever is less.

| | |
|------------------------------|--|
| Pipe Size (Round equivalent) | Maximum Joint Opening |
| 12"-24" | 1/4" |
| 27"-84" | 1/8"/ft. of equivalent internal diameter, max. 5/8" |

90" and larger 3/4"

The above maximum openings are for the purpose of compensating for minor irregularities in the manufacture of the pipe joints. The pipe is to be laid to line and grade so that the sections are pushed completely home at least one point around the circumference of the joint, without spalling the concrete. Permissible openings may exist at other points around the circumference of the pipe.

In laying pipe, the maximum rubber gasket joint pull and deflection shall not exceed the manufacturer recommendations.

(5) Bends

When special engineering conditions exist, the City Engineer may allow bends. Bends for concrete pipe shall be fabricated from segments of a steel cylinder with concrete or mortar lining and reinforced concrete exterior covering or from segments of concrete pipe miter cut while the pipe is still green. The deflection angle between adjacent segments shall not exceed 30°.

Steel cylinders shall be at least U.S. 10 gauge and shall be lined with concrete or mortar at least three-quarters inch thick. Bends fabricated from steel cylinders shall be designed for the same three-edge bearing loads as the adjacent pipe.

In bends fabricated from miter cut segments of concrete pipe, the reinforcing steel shall be welded and the entire bend shall be encased in concrete after installation. Concrete encasement shall be at least eight inches thick all around and shall extend the full length of the bend.

(6) Handling

Pipe, fittings, and accessories shall be handled in a manner that will insure installation in sound, undamaged condition.

Concrete pipe and fittings shall be handled carefully and shall not be bumped or dropped. No hooks shall be permitted to come in contact with joint surfaces. Pipe units shall be kept from contact with adjacent units during handling and storage.

Lift holes are prohibited for all concrete storm sewer pipe.

(7) Cleaning

The interior of all pipe and fittings shall be thoroughly cleaned of foreign matter before being installed and shall be kept clean until the work has been approved. All joint contact surfaces shall be kept clean until the jointing is completed.

Every precaution shall be taken to prevent foreign material from entering the pipe during installation. No debris, tools, clothing, or other materials shall be placed in the pipe. Whenever pipe laying is stopped, the open end of the line shall be suitably closed. Culverts, sewers, and drains shall have the upper end closed with an end board closely fitting the end of the pipe and having a number of small holes drilled near the center to prevent the trench from filling with water. All water that may have entered the trench shall be pumped out before the closure is removed. It is essential that no mud, sand or other material shall be placed in the pipe.

(8) Alignment

Piping shall be laid to the lines and grades shown on the drawings. Storm sewers shall be designed with straight pipe runs between structures. Where warranted by special engineering conditions, the City Engineer may approve the design of curved sections. Pipe lines or runs intended to be straight shall be laid straight. Curves may be formed by using fittings or mitered joints or by opening the joints for pipe 36 inches in diameter and larger. Complete curve data shall be shown on the plans. The contractor shall erect hub stakes to determine and check pipe subgrades. Not less than three hub stakes shall be maintained in proper position at all times when trench grading is in progress. If a laser beam is not used, batter boards shall be used at intervals of not more than 25 feet.

(9) Laying Pipe

Pipe shall be protected from lateral displacement by pipe embedment material. Under no circumstances shall pipe be laid in water and no pipe shall be laid under unsuitable weather or trench conditions.

Pipe shall be laid with the bell ends facing upstream unless an exception is granted by the City Engineer. Prior to assembling each joint, the new pipe section being added to the already installed pipe(s), shall be on line and grade to help insure uniform gasket contact around the entire perimeter of the bell end.

(10) Handrails

As required, shall be fabricated steel handrail and guard fence shall be hot dip zinc coated in accordance with the latest edition of ASTM A 123. Hardware for handrail and guard fence shall be hot dip zinc coated in accordance with the latest edition of ASTM A 123.

y. Corrugated Metal Pipe

All pipe, pipe couplings, and accessories therefore shall be unloaded, stockpiled, hauled, distributed, and otherwise handled in a manner which will prevent damage thereto. Care shall be taken to insure that no damage will occur to coating of pipe and pipe couplings. All hooks or other tools inserted in the ends of the pipe, and slings if used in contact with the outside of the pipe, shall be well padded.

All pipe coating which has been damaged prior to laying the pipe or placing the backfill shall be repaired in strict conformity with the pipe manufacturer's instructions and recommendations, using materials of a type and quality equal to that used in originally coating the pipe.

Special care shall be taken to lay all pipe to exact grade and line. All pipe, when jointed, shall form a true line of sewer. Any pipe that has a grade or joint disturbed after laying shall be taken up and re-laid. All pipes shall be laid with the separate sections joined firmly together, with outside laps of circumferential joints pointing upstream, and the center line of the invert coinciding with the specified alignment of the pipe.

The interior surfaces of all pipe shall be thoroughly cleaned of all foreign matter before being lowered in the trenches and shall be kept clean during laying operations. In addition, the exterior surfaces of the ends of corrugated metal pipe over which the coupling bands are to be installed, and all interior and exterior surfaces of the bands shall be both clean and dry when the pipe is laid and the joints coupled as required.

Coupled joints shall be made in strict conformity with the corrugated metal pipe manufacturer's recommendations and instructions, using watertight coupling bands and accessories as specified above.

817.4 MEASUREMENT AND PAYMENT

The Engineer will measure the various sizes of storm sewer pipe by the linear foot, along the centerline of the pipe, from the center to center of structures, unless otherwise noted on the plans.

The Engineer will measure each end section by the specified size and type.

Payment for "Storm Sewer" and "End Section" at the contract unit prices bid is full compensation for the specified work. Concrete toe walls and/or bar grates shall be considered subsidiary to end sections. Prices shall be full compensation for excavating (including rock if necessary), bedding, backfill, and for furnishing all materials necessary to complete the work and shall include all costs in modifying the existing damaged pipes or structures affected by this work.