

CHAPTER 9

SEWER / STORM DRAIN / IRRIGATION LINES

SECTION 9.01 GENERAL

This section covers the requirements for piping materials and installation of Lehi City sewer, storm drainage and irrigation collection systems. Variances to the requirements of this section require the approval of the City Engineer. All materials and workmanship shall strictly comply with the International Plumbing Code and the Utah State Health Department criteria. All lines shall be pressure tested and televised by the City prior to acceptance.

SECTION 9.02 BUILDING SUBSURFACE DRAINS (PERIMETER, ETC.)

- A. All subsurface drains shall comply with the Standard Drawing unless otherwise approved by the Public Works Department.

SECTION 9.03 IRRIGATION LINES

- A. Irrigation lines installed during the development process shall meet and/or exceed the requirements herein unless approved otherwise by the Irrigation Company or User. However, if the pipe is in a City right-of-way, the City may require a more stringent standard than the Irrigation Company or User.

SECTION 9.04 PIPE LAYING

- A. All sewer, storm drainage and irrigation pipe installations shall proceed up grade on a stable foundation with joints closely and accurately fitted. Gaskets shall be fitted properly in place and care shall be taken in joining the pipe units to avoid twisting of gaskets. Joints shall be clean and dry and a joint lubricant, as recommended by the pipe supplier, shall be applied uniformly to the mating joint surfaces to facilitate easy positive joint closure.
- B. If adjustment of position of a pipe length is required after being laid, it shall be removed and rejointed as for a new pipe. When pipe laying is not in progress, the ends of the pipe shall be closed with tight fitting stoppers to prevent the entrance of foreign material.
- C. In addition to the above requirements, all pipe installation shall comply with the specific requirements of the pipe manufacturer.

SECTION 9.05 GRADES

- A. Unless otherwise approved by the City Engineer, all sewer, storm drainage and irrigation pipe grades shall be established by the use of an approved laser beam method. An above

ground method shall not be used. Constructed tolerance shall be ± 0.05 feet of approved design elevations.

SECTION 9.06 CONCRETE SEWER, STORM DRAIN OR IRRIGATION PIPE

- A. Concrete pipe may be used for all sanitary sewers and storm drains up to and including 18-inch size unless otherwise specifically designated in these Specifications, or on the approved Drawings, or as recommended by the manufacturer for specific loadings, etc. Pipe shall be Class Three pipe manufactured to comply with the requirements as set forth in ASTM Designation C14. Joints shall be of the bell and spigot rubber gasket design with joints and gaskets conforming to the requirements of ASTM Designation C443. Pipe joints shall be so designed as to provide for self-centering, and when assembled, to compress the gasket to form a water-tight seal. The gasket shall be confined in a groove on the spigot, so that pipe movement or hydrostatic pressure cannot displace the gasket.

SECTION 9.07 REINFORCED CONCRETE PIPE

- A. Reinforced concrete pipe shall be used for all sanitary sewers and storm drains of size larger than 24-inches, (except as allowed for HDPE pipe), and for all sewers and drains of smaller size where installation does not provide a cover of at least 3 feet over the top of the pipe. Depending on trench conditions, etc., a higher class pipe may be required. Reinforced concrete pipe shall comply with the requirements of ASTM C-76 (Class III) with bell and spigot rubber gasket type joints for sanitary sewers and the alternate option of tongue and groove mortar joints for storm drain lines.

SECTION 9.08 PLASTIC SEWER PIPE

This specification covers rigid polyvinyl chloride pipe and fittings, hereinafter called PVC pipe and PVC fittings. The pipe and fittings shall meet or exceed all of the requirements of ASTM Specification D-3034 Type PSM for SDR 35 pipe. PVC pipe may be used for all sanitary sewers up to and including 18 inch.

- A. Samples of pipe, physical and chemical data sheets shall be submitted to and approved by the City Engineer before pipe is purchased.
- B. Pipe shall be homogeneous throughout and free from cracks, holes, foreign inclusions or other defects. The pipe shall be as uniform as commercially practical in color.
- C. All PVC sewer pipe shall be made from clean, virgin, Type 1, Grade 1, PVC conforming to ASTM resin specification D-1784. All pipe joints shall be bell and spigot type with rubber ring gasket to permit expansion and contraction. Pipe and fittings must be assembled with nontoxic lubricant. All pipes shall be less than 20 feet in length.
- D. Spigot ends will have 15 degree tapered ends with memory mark around the diameter of

the pipe to indicate proper insertion depth.

- E. Wyes shall be of the same material as the pipe, and in no case shall have thinner walls than that of the pipe furnished. Sample wyes must be submitted for the City Engineer's approval, and his approval must be obtained before purchase of the wyes.
- F. All polyvinyl chloride (PVC) gravity sewer pipe shall be tested for deflection by the Contractor.
- G. Testing shall be accomplished by using a deflectometer which will produce a continuous record of pipe deflection or by pulling a mandrel go/no-go device approved by the City Engineer, through the pipeline. The diameter of the go/no-go device shall be ninety-five (95) percent of the undeflected inside pipe diameter as determined by the nominal diameter.
- H. All pipe exceeding a maximum ring deflection of five (5) percent of the vertical internal pipe diameter shall be considered to have failed. Such pipe shall be relayed or replaced between manholes where such failure occurred by the Contractor.
- I. Each section which has been relayed or replaced due to failure of the deflection test shall be retested by the Contractor.
- J. Force main sewers shall be a DR18 C900 PVC, unless otherwise approved by the City Engineer.

SECTION 9.09 CORRUGATED HIGH DENSITY POLYETHYLENE PIPE

This specification covers Corrugated (smooth inner wall) High Density Polyethylene Pipe (HDPE) & Fittings which may be used for storm drainage pipe sized from 12 inches up to and including 24 inches in diameter unless otherwise specifically designated in these specifications or on the approved drawings. Smaller sizes of HDPE pipe may be used for subsurface drainage within private storm drainage facilities when approved by the Public Works Director. Pipe cover shall be as recommended by the supplier, but in no case shall it be less than 36 inches unless specifically approved by the Public Works Director.

- A. High Density Polyethylene (HDPE) Corrugated Pipe (smooth inner wall) & Fittings shall have a full circular cross section, with an outer corrugated pipe wall and a smooth inner wall per the latest edition of AASHTO M294 Type S for diameters 12 inches to 24 inches and the latest edition of AASHTO M252 for pipe diameters 3 inches to 10 inches. HDPE Corrugated Pipe shall be manufactured from virgin PE compounds which conform with the requirements of cell class 424420C for 4 inches through 10 inches and 435400C for 12 inches through 24 inches as defined in ASTM D 3350.

- B. Joints shall meet one of the following: Soil tight joints shall be as specified in ASTM F 2306. Watertight joints must meet a 74kPa (10.8 psi) laboratory test per ASTM D3212 and utilize a bell and spigot design with a gasket meeting ASTM F477.
- C. Gaskets shall be made of polyisoprene meeting the requirements of ASTM F477. Gaskets shall be installed by the pipe and manufacturer and covered with a removable, protective wrap.

SECTION 9.10 STORM DRAIN INLETS AND COMBINATION BOXES

- A. Inlet box grates, curb type with either hood (throat) or grate only may be used for single pipe connections only. Wherever two or more pipes intersect, a combination box, manhole or drain clean out box must be used.

SECTION 9.11 MANHOLES

A. GENERAL.

The Contractor shall furnish and install watertight cast-in-place or precast concrete manholes at the locations shown on the Drawings approved by the City. Manholes shall be furnished complete with cast iron rings and covers. Manhole spacing shall not exceed 400 lineal feet unless otherwise approved by the City Water Department. Manholes shall be 4 feet in diameter for pipes 12 inches and smaller, 5 feet for 15 inch to 24 inch pipes, and larger size manholes as approved by the City Water Superintendent for pipes larger than 24 inches. Larger manholes may be required depending on pipe sizing and orientation of pipe within manhole.

B. FOUNDATION PREPARATION.

Dewatering of the site shall conform to the requirements for pipe trench dewatering within these Standards. Adequate foundation for all manhole structures shall be obtained by removal and replacement of unsuitable material with well graded granular material; or by tightening with coarse ballast rock, or by such other means as provided for foundation preparation of the connected piping, or as required by the City Engineer. Where water is encountered at the site, all cast in place bases shall be placed on a one-piece waterproof membrane, so placed as to prevent any movement of the water into the fresh concrete. Precast base sections shall be placed on a well graded granular bedding course conforming to the requirements for pipe bedding but not less than 8 inches in thickness and extending either to the limits of the excavation or to a minimum of 12 inches outside the outside limits of the base section. In the latter case, the balance of the excavated area shall be filled with select material well tamped to the level of the top of the bedding to positively prevent any lateral movement of the bedding when the weight of the manhole is placed upon it. The bedding course shall be firmly tamped and made smooth and level to assure uniform contact and support of the precast elements.

C. BASES.

1. Cast-in-place bases shall be at least 8 inches in thickness and shall extend at least 6 inches radially outside of the outside dimension of the manhole section. Precast bases shall be a minimum of 8 inches in thickness.
2. The concrete base shall be constructed so the first section of the precast manhole has a uniform bearing throughout the full circumference of the manhole wall. Sufficient mortar shall be deposited on the concrete base to provide a water tight seal between the base and the manhole wall. Concrete used in the construction of the base shall conform to Class B concrete as specified in section 5 of these Standards.
3. Where sewer lines pass through or enter manholes, the flow channel should be made to conform in shape and slope to that of the sewer pipes entering and exiting the manhole. Flow channels should be smooth and semi-circular in cross section carried up vertically to the crown elevation of the various pipes. Changes of direction of flow within the manholes shall be made with a smooth curve with as long a radius as possible. The floor of the manhole outside the flow channels shall be smooth and slope toward the channel at not less than 1/2 inch per foot.
4. Sewers shall be laid with uniform slope between manholes.

D. WALL AND CONE SECTIONS.

1. All manholes shall have a minimum of 48 inch I.D. precast, or larger as required by the Standard Drawings or City Engineer, sectional, reinforced concrete pipe. Both cylindrical and taper sections shall conform to all requirements of ASTM Designation C-76 for Reinforced Concrete Culvert Pipe with the following exceptions:
 - a. The throat section of manholes may be adjusted up to 12 inches with concrete grade rings. However, no more than 3 inches of cast iron grade rings may be included within this 12 inch grade ring dimension.
 - b. The taper section shall be a maximum of 3 feet in height, shall be of concentric conical design, and shall taper uniformly from 48 inches to 30 inches inside diameter.
 - c. The 48-inch min. inside diameter pipe used in the base section shall be furnished in section lengths of 1, 2, 3 and 4 feet as required.
 - d. Reinforcing steel shall consist of a circular cage with a minimum cross sectional area of three-tenths (0.3) of a square inch of steel per foot in both directions.

- e. Steps are required in all manholes, vaults, & boxes (as indicated on the City Standard Details). The first step shall be 18 inches above the bottom of the floor.
2. All joint surfaces of precast sections and the face of the manhole base shall be thoroughly cleaned and wet prior to setting precast sections.
3. Joints shall be set in mortar consisting of 1 part cement and 1-1/2 parts sand with sufficient water added to bring the mixture to workable consistency, or the joints shall be sealed with a butyl rubber gasket that is permanently flexible and non-shrinking, similar to Brandt No. 95 Cold Weather Vault Sealant.

E. PIPE CONNECTIONS.

1. All pipes entering or leaving the manhole shall be placed on firmly compacted bedding, particularly within the area of the manhole excavation which normally is deeper than that of the pipe trench.
2. Pipe-to-manhole connections for sanitary sewer pipe shall be accomplished with connecting boots. The connecting boots shall be made of neoprene compound meeting ASTM C-443 specifications. The boot shall have a wall thickness of 3/8-inch. The boot shall either be "cast-in-place" in the pre-cast base or attached to the pre-cast base by means of an internal expanding band. When the boot is attached to the pre-cast base, a watertight seal between the boot and the pre-cast base must be accomplished. An external band shall be supplied and used to clamp and seal the boot to the pipe. The band shall be made of 300 series non-magnetic corrosion-resistant stainless steel. After the connecting boot has been installed, special care shall be taken to see that the inside openings through which the pipes enter the structure are completely and firmly rammed full of mortar.
3. Pipe-to-manhole connections for storm drain and other drainage pipe shall be completely and firmly rammed full of mortar to ensure water tightness. An 8-inch thick concrete field joint shall also be installed on the outside of the manhole around the pipe-to-manhole connection.

F. BACKFILL.

Backfill around the manhole and extending at least one pipe length into each trench shall be hand placed and hand tamped with select material up to an elevation of one foot above the top of each pipe, regardless of the specifications for backfilling the pipe trenches adjacent thereto. The balance of the backfill shall conform to the requirements for trench backfilling.

G. COVERS AND FRAMES.

1. All iron castings shall conform to the requirements of ASTM A 48 (Class 30) for grey iron castings. Rings and covers shall be equal to the Salt Lake City Standard with machined bearing surfaces and with minimum cover weight of 150 pounds and minimum ring weight of 233 pounds. Any cover which tends to rock or tip will be rejected. In addition to the foundry name and year of manufacture, the cover shall be marked "SEWER", for sanitary sewers and "STORM DRAIN" for storm drainage systems. Storm drain manhole and box covers must be vented with holes. Slotted storm drain covers may be used, but only as approved by the Public Works Director.
2. All manhole rings shall be carefully set to the grade shown on the approved drawings or as directed by the City Engineer. The manhole ring and covers shall be so installed to match the grade and cross slope of roadway. Where work is in paved streets, not less than 6 inches or more than 12 inches shall be provided between the top of the cone or slab and the underside of the manhole casting ring for adjustment of the casting ring to street grade. "Twist Riser" or "Rotating Adjustable" Manhole ring and covers may be required due to road grade conditions.

SECTION 9.12 CLEANING AND TESTING SANITARY SEWER, STORM DRAINAGE AND IRRIGATION LINES AND MANHOLES

- A. CLEANING. After the sewer, storm drainage or irrigation lines have been laid and the trench backfilled, they shall be thoroughly cleaned and tested for leakage and alignment in the presence of the City Engineer or City Inspector before acceptance by the Owner. Laterals and trunk lines shall be flushed by water to remove all foreign material. Waste water and debris shall not be permitted to enter pipe lines in service, but shall be removed at the lowest manhole of the excavation. The scouring action shall be accomplished by hydraulic or jet cleaning. Other methods may be used upon approval of the City Engineer. After the lines have been thoroughly cleaned, they shall be tested between all manholes for displacement.
- B. DISPLACEMENT TEST. The displacement test shall be supervised and conducted by the City Engineer or City Inspector and shall consist of both of the following: (1) A light will be flashed between the manholes, or if the manholes have not as yet been constructed, between the locations of the manholes, by means of a flashlight or by reflecting sunlight with a mirror. If the illuminated interior of the pipe shows broken, misaligned or displaced pipe, or other defects, the defects designated by the City Inspector shall be remedied by the Contractor; (2) After subbase has been placed and compacted, prior to asphalt placement, the sewer, storm drainage or irrigation line(s) will be televised. The affected owner may elect to be present during the television inspection process. The initial inspection shall be provided at no cost to the Owner. If the pipeline is found to be unacceptable, the problem shall be corrected by the Contractor and re-televised. The Owner shall be charged for these additional inspection(s). Television inspection must be scheduled at least one (1)

week in advance of date inspection is required.

C. LEAKAGE TESTS. The Contractor shall test all sanitary sewer, storm drainage or irrigation pipe by means of exfiltration and infiltration tests. Length of the line tested at one time shall be limited to the length between adjacent manholes.

D. EXFILTRATION TEST.

1. Each section of sewer, storm drain or irrigation pipe, manholes and boxes shall be tested between successive manholes by closing the outlet of the manhole or box at the lower end of the pipe to be tested and the inlet of the manhole or box at the upper end of the pipe with stoppers. The pipe and manhole shall be filled with water to a point approximately 4 feet above the invert of the pipe at the center of the upper manhole or to 4 feet above the natural groundwater level, whichever is higher.

The allowable leakage will be computed by the formula: $E = 0.25 (D)(H)$

Where:

E is the allowable leakage in gallons per hour per 1000 feet of sewer, storm drain or irrigation tested.

D is the internal diameter of the pipe in inches.

H is the difference in elevation in the water surface in the upper manhole and the invert of the pipe at the lower manhole (feet).

2. If the leakage from the manholes and pipe sections as shown by the test exceeds that allowed by the formula, the Contractor will make the necessary corrections to reduce the exfiltration to within permissive limits.
3. Where the difference in elevation between inverts of adjacent manholes exceeds 10 feet, the exfiltration leakage test will be modified as directed by the City Engineer or City Inspector.
4. House surface laterals shall be considered part of the main line sewer to which they are connected and shall be tested with the main line sewer.

E. ALTERNATE EXFILTRATION TEST.

1. Air pressure testing may be used in lieu of the water exfiltration test subject to the approval of the City Engineer or City Inspector. The low pressure air test shall be conducted by the following method under the direction of the City Engineer or City Inspector with equipment equal to Cherne Industrial, Inc.
2. All wyes, tees, or ends of lateral stubs shall be suitably capped and braced to withstand the internal test pressures. Caps shall be easily removable for future lateral connections or extensions.

3. After a manhole to manhole section of line has been backfilled and cleaned, it shall be plugged at each manhole with pneumatic plugs. One of the plugs shall have three hose connections. Air for inflation of the triple connection pneumatic plug shall be supplied through a factory equipped control panel. There shall be three hose connections from the control panel to the pneumatic plug. One hose shall be used for inflations of the plug. The second hose shall be used for continuously reading the air pressure in the sealed line. The third hose shall be used for introducing low pressure air into the sealed line.
4. There shall be a 3-1/2 inch or larger diameter, 0.30 psig gauge mounted on the control panel for reading of the internal pressure in the line being tested. Calibrations from the 0-10 psig range shall be in tenths of pounds and the 0-10 psig portion shall cover 90% of the complete dial range.
5. Low pressure air shall be introduced into the sealed line until the internal air pressure reaches 4 psig greater than the average back pressure of any ground water that may be over the pipe. At least two (2) minutes shall be allowed for the air pressure to stabilize. After the stabilization period (3.5 psig minimum pressure in the pipe), the third hose shall be disconnected from the control panel.
6. The portion of line being tested shall be accepted if the portion under test does not lose air at a rate greater than 0.003 cubic feet per minute per square foot of internal pipe surface of 2.0 cubic feet per minute minimum when tested at an average 3.0 psig greater than any back pressure exerted by ground water that may be over the pipe at the time of the test.
7. For PVC pipe the pipe and joints shall also be considered acceptable when the time required in minutes for pressure to decrease from 3.5 to 2.5 psig (greater than the average back pressure of any ground water that may be over the pipe) shall not be less than the time shown for the given diameters in the following tables:

<u>Pipe Diameter in Inches</u>	<u>Minutes</u>
4	2.0
6	3.0
8	4.0
10	5.0
12	5.5
15	7.5
18	8.5

For all concrete pipe use ASTM C924 or C969.

8. If the installation fails to meet this requirement, the Contractor shall determine at his

own expense the source of leakage. He shall repair or replace all defective materials and/or workmanship.

F. INFILTRATION TEST.

1. In addition to the exfiltration test, the newly laid sewer, storm drain or irrigation system shall also comply with the following infiltration requirements. Infiltration tests shall be conducted by placing an approved calibrated V-notch weir in the line just above the next lower manhole and plugging the line just above the next higher manhole. Sufficient time shall be allowed for the water level behind the weir to stabilize before reading. Dislodge any foreign material obstructing the weir before reading. Take successive readings until consistent results are obtained.
2. Whenever the rate of infiltration is found to exceed the maximum, conduct electronic or photographic visual inspection of the interior of the pipeline. Make repairs and continue to test the conduit until it is within specified limits prior to proceeding with further construction. Make repairs at all manholes to exclude all infiltration occurring, whether or not they are within specified limits. All identified leaks must be fixed.
3. The maximum allowable infiltration for any section of the system shall be as follows, subject to the limitations described hereafter:
 $I = 200$ gallons/mile/inch-diameter/day
4. Upon completion of all sectionalized testing, the total project infiltration of the newly constructed system shall be measured and recorded. This value shall be limited to 125 gallons/mile/inch-diameter/day. Make repairs and continue to test for total project infiltration until it is within this specified limit.