# SECTION 14
# SEWERS

## 14.01 DESCRIPTION

This work shall include the furnishing of all the labor, materials, tools, equipment, and incidentals to construct and complete, in an efficient and workmanlike manner, the installation of the sanitary sewer mains and laterals in accordance with the approved plans, standard details, and these specifications.

## 14.02 MATERIALS

A. GRAVITY SEWER PIPE
   1. Polyvinyl Chloride (PVC) Pipe and fittings shall, at a minimum, conform to the requirements of ASTM Designation D3034 as they apply to SDR-26 (laterals) and SDR-35 (mains) PVC sewer pipe using an elastomeric gasket joint in a bell and spigot assembly system. PVC gravity main sewer pipe and fittings shall conform to ASTM D3034 SDR-35 sewer pipe for diameters from four (4) inch through fifteen (15) inch and ASTM F679 for diameters from eighteen (18) inch through thirty-six (36) inch. The City Engineer may require certification by the manufacturer that the test results comply with specification requirements. Pipe laid deeper than twenty (20) feet below grade may require additional requirements and subject to approval by the City Engineer.

      The pipe shall have a home mark to indicate full penetration of the spigot when a joint is made. The date of manufacture shall be marked on the pipe. Pipe being installed shall have been manufactured within twelve (12) months of the date of installation.
   2. Reserved.
   3. Ductile Iron Pipe and fittings shall conform to the requirements of ANSI/AWWA C151/A21.51 and shall have a minimum forty (40) mil polyurethane lining and eight (8) mil polyethylene encasement.
   4. All other gravity sewer pipe shall require special approval from the City Engineer.

B. PRESSURE SEWER PIPE - Whenever the design of a sanitary sewer system includes the necessity of a sewage lift station and/or pressure mains, types of pipe shall be approved by the City Engineer for each specific case. If ductile iron is used, the minimum class of pipe and fittings shall be Pressure Class 350. If PVC pipe is used, the minimum class of pipe and fittings shall be C-900.

C. JOINTS AND COUPLINGS
   1. Polyvinyl Chloride Joints shall be bell and spigot using an elastomeric gasket, which meets the requirements of ASTM Designation F-477. Connections to manholes, or other concrete structures shall be made by utilizing manhole adaptors or

elastomeric seal rings embedded in the concrete.

2. Banded rubber couplings shall conform to the requirements of ASTM Designation C-425 and shall have a stainless-steel shear band.

D. FITTINGS - All fittings shall be manufactured of the same materials as the pipe and installed in accordance with the Standard Details.

E. LATERALS

1. Sanitary sewer pipe laterals shall be of the same material type and designation as that used for the main sanitary sewer pipe. The use of four (4) inch diameter SDR-35 PVC sewer pipe and fittings will not be permitted. Four (4) inch or six (6) inch diameter SDR-26 PVC sewer pipes and fittings shall be used for laterals for both SDR-26 and SDR-35 PVC sewer mains. Larger diameter laterals require special approval by the City Engineer.
2. Joints and Couplings for laterals shall be of the same type and specifications as those used for the main except that four (4) inch diameter SDR-35 PVC sewer pipe will not be permitted.

F. MANHOLES -Sanitary sewer manholes shall be 4,000-psi minimum concrete cast-in-place or precast reinforced concrete conforming to ASTM Designation C-478. Manholes shall be constructed in accordance with the Standard Details.

Iron castings for manhole covers and frames shall conform to ASTM Designation A-48, Class 35 and be of the dimensions shown on the Standard Details.

The weight of the frame of a twenty-four (24) inch manhole cover and frame shall be one hundred forty (140) lbs. +/- ten (10) lbs. The weight of the cover shall be one hundred thirty (130) lbs. +/- five (5) lbs. All manhole frame and covers shall be required to handle a H-20 vehicle load rating.

All castings shall be sound and free from shrinkage cracks, blow holes, and other defects. All fins and burnt sand shall be removed. Excessive porosity and spongy surfaces will constitute causes for rejection. The City Engineer shall be the judge as to whether the defects are sufficient to cause rejection.

The manhole cover shall seat evenly and firmly in the frame. Seating surface shall be closely machined to nominal dimensions with tolerances not to exceed +/- one sixty-fourth (1/64) of an inch. Cast iron frames and covers shall be dipped or painted with asphalt which will form a tough, tenacious, non-scaling coating which does not have a tendency to become brittle when cold or sticky when hot.

G. MANHOLE LINING - The Contractor shall line the interior of new manholes located on trunk lines ten (10) inches or greater in diameter, manhole locations immediately downstream of a force main discharge, manholes with an inside drop or other locations where sewer gases can develop as determined by the City Engineer, The lining system shall consist of etching, prime coats and finish coats. The lining options are as follows:

1. Coal Tar Epoxy

a. Surface: Concrete submerged or subject to moisture. Manhole Lining shall not be applied until after a full twenty-eight (28) day cure period for any mortar finishing or repair work is completed on the manhole structure.
b. Surface Preparation: Concrete surface shall be etched and rinsed clean prior to painting.
c. Coatings: Primer - as recommended by Coal Tar Epoxy manufacturer.
d. Finish - two coats - Carboline Bitumastic 300M, Tnemec 46H-413 or equal.
e. Dry Film Thickness - 16-mil total.
f. Manhole Liner Testing Requirements - Liner testing shall comply with Sections 502-5 and 502-6 of the latest edition of the "Greenbook" Standard Specifications for Public Works Construction, as published by BNi Publications, Inc.

2. Epoxy
a. Surface: Concrete submerged or subject to moisture. Manhole Lining shall not be applied until after a full twenty-eight (28) day cure period for any mortar finishing or repair work is completed on the manhole structure.
b. Surface Preparation: Concrete surface shall be etched and rinsed clean prior to painting.
c. Coatings: Primer - one coat - Sikagard 693, Concresive 1170, or equal. Primer shall be applied per manufacturer's requirements.
d. Finish - one coat - Sherwin Williams Dura-Plate 6100, or equal.
e. Dry Film Thickness - 16-mil total.
f. Manhole Liner Testing requirements - Liner testing shall comply with Sections 502-5 and 502-6 of the latest edition of the "Greenbook" Standard Specifications for Public Works Construction, as published by BNi Publications, Inc.

H. CLEANOUTS - Sanitary sewer cleanouts shall be located and constructed in accordance with the Standard Details.

## 14.03 INSTALLATION

A. SANITARY SEWER INSTALLATIONS

1. General - All sanitary sewer pipe installations shall be accomplished as specified herein except where modified by the requirements specific to the various types of pipeline materials specified under Section 14.02 above. All trench excavation and backfilling work shall be accomplished in accordance with the requirements of Section 12 of these Standard Construction Specifications and the Series 100 City Standard Details.

   All flexible (non-rigid) pipe shall be delivered and handled by means which will provide adequate support to the pipe and does not subject it to undue stress or damage. When handling and placing pipe, care shall be taken to prevent impact blows, abrasion damage, and gouging or cutting (by metal surface or rocks). The

manufacturer's special handing requirements shall be strictly observed. Special care shall be taken to avoid impact when the pipe is handled at a temperature of forty (40) degrees or less. Pipe shall be stored on a relatively flat surface so that the full length of the pipe is evenly supported. The pipe, fittings, and gaskets shall be covered with an opaque material when outdoors for a period of fifteen (15) days or longer. Any pipe, fittings, or gaskets found to be damaged by weather or handling by the City Inspector shall be removed and replaced by the Contractor at their expense. The City Inspector has sole authority to make such determination.

Green insulated tracer wire and warning/marker tape shall be installed for all pressure sewer mains, gravity mains, service laterals, on curved roadway alignments and at other locations as determined by the City Engineer. Tracer wire shall be solid copper with USE rated green insulation and minimum size of ten (10) AWG, Tracer wire shall be interconnected at all mains and laterals and shall be taped of five (5) feet intervals. Maintenance access points for tracer wire shall be between manhole frame and grade rings for manholes and at cleanout boxes as shown on City Standard Details. Warning/marker tape shall be twelve (12) inches wide, green plastic (non-detectable), and marked "Caution Sewer Line Below" or approved equal and placed on top of pressure sewer mains and gravity mains and laterals. Warning/marker tape shall be placed just above the initial backfill.

Main and trunk sewers shall have a minimum depth of four (4) feet measured from top of pipe to finished grade. Laterals shall have a minimum depth of three (3) feet from top of pipe to finished grade. Any sewer pipe that exceeds twenty (20) feet may require a stronger pipe and is subject to approval by the City Engineer. Refer to additional requirements in the Design Standards, Section 5.02. All sewer pipe shall be laid with a minimum of twelve (12) inches vertical clearance below water lines and six (6) inches clearance from all other improvements and utilities, unless otherwise approved by the City Engineer. Sewer pipe that is placed in the proximity of water lines require approval from the SWRCB, Division of Drinking Water and shall comply with the separation requirements detailed in City Standard Details #409 and #410.

All sewer pipe shall be laid to conform to the prescribed line and grade as shown on the plans and each pipe length checked to the grade line, which the Contractor establishes from the grade stakes or other method approved by the City Engineer.

The grade line shall be established before any pipe is laid in the trench. The Contractor shall submit the method of setting grade for City approval prior to starting work. Use of commercial LASER grade setting equipment shall meet the following requirements and conditions are met:

a. The Contractor shall have the responsibility of providing an instrument operator who is qualified and trained in the operation of the LASER and said operator must adhere to the provisions of the State of California Construction

Safety Orders issued by the Division of Industrial Safety. Attention is particularly directed to Sections 1516, 1800, and 1801 of said Orders for applicable requirements.

b. All LASER control points shall be established benchmarks or construction off-set stakes identified on cut sheets and set in the field for the work. LASER set up points shall be these control points or points set directly from them by instrument.

Each length of pipe shall be laid on approved bedding material mechanically consolidated as specified and shall have full bearing for its entire length between bell holes excavated in said bedding material to allow for unobstructed assembly of all bell and spigot joints. “Swinging In” or “Popping On” spigot ends of pipe into bell ends will not be permitted. After jointing is accomplished, all annular spaces between pipe and bell holes shall be packed with bedding material, taking care not to damage, move or lift the pipe from its bedding support. Minimum length of pipe installed shall not be less than five (5) feet unless approved by the City Engineer, excluding pipe lengths installed at manholes. Pipe shall be laid such that the manufacturer’s markings are on the top of the pipe and visible.

Adjustments of pipe to line and grade shall be made by scraping away or filling in and tamping approved bedding material under the body of the pipe. No wedging or blocking to support the pipe will be permitted.

A sewer line, unless otherwise approved by the City Engineer, shall be laid, without break, upgrade from point of connection to existing sewer and with the bell end forward or upgrade. When pipe laying is not in progress, the forward end of the pipe shall be kept effectively closed with an approved temporary plug or cap.

Sewer pipes, laterals, stubs, or other open ends, which are not to be immediately connected, shall be plugged or capped with a standard manufactured watertight plug or cap, suitable for use on the type of pipe. The plug or cap shall be placed on a standard end.

Pipe entering or leaving manholes or other structures shall have joints within two and one half (2-1/2) feet of the manhole base.

In all cases, flexibility of joints in or at the manhole base shall be preserved to prevent damage to the pipe by differential settlement.

All sewer line connections to manholes, trunk sewers, main sewers, or side sewers shall be left uncovered until after the inspection has been made. After approval of the connection, the trench shall be backfilled, as specified. The City Engineer may, at his discretion, require special pipe to be laid in areas that are

potentially unstable or subject to settlement.

If the sewer is to be laid in an area that is to be filled, and the cover prior to filling is less than five (5) feet, the pipe shall not be laid until the area has been filled to a level five (5) feet above the proposed pipe and compacted to ninety (90) percent relative compaction, unless otherwise authorized by the City Engineer.

When a new sewer is extended from other than an existing manhole and the first new manhole upstream of the connection established conditions prescribed in Section 5.03.F.6 of the Design Standards, the Contractor installing such new facilities shall also be responsible for installing backflow prevention devices on service laterals in conformance with said Section on existing side sewers so affected.

B. LATERALS - Attention is directed to the Standard Details for additional details and requirements pertinent to lateral installations.

The use of saddles on the sanitary sewer main for sanitary sewer lateral connections will not be permitted.

That portion of any lateral line to be placed under an existing concrete curb and gutter and/or sidewalk shall be done by boring or cutting and replacing the existing concrete curb and gutter and/or sidewalk.

Where applicable, a two (2) inch x two (2) inch letter “S” shall be stamped, chiseled, cut, etc. on the top of all concrete curbs on all sanitary sewer laterals directly above the location where the lateral crosses the flow line of the gutter.

The lateral line shall have a clean-out at the back edge of the sidewalk as shown on Standard Detail No. 401 and 401A. Laterals and cleanouts shall not be located in driveways unless approved by the City Engineer.

When a backflow prevention device is required under Section 5 of the Design Standards, such installations shall be made after final grading around the building has been completed and at a location where sewage can overflow without serious property damage on adjacent areas. It shall be the responsibility of the Contractor installing backflow prevention devices to see that informational notices, for present and future owners, regarding the importance of such devices are conspicuously posted upon the device and on the structure by said device.

C. MANHOLES - Precast Manhole Construction - All precast manholes shall be excavated and backfilled in conformance with the requirements of Section 19-3 of the State Standard Specifications and installed as specified herein. All bedding and initial backfill material under, around and at least six (6) inches over all pipelines located within five (5) feet of structure bases shall be compacted without jetting, prior to barrel section placements. All precast manholes shall be constructed to subgrade prior to

placement of structure backfill around the manhole.

All joint surfaces of precast sections and face of manhole base shall be thoroughly cleaned prior to setting precast sections. Precast manhole sections shall be sealed with a joint sealer. The joint sealer shall meet the requirements of Federal Specification SS-S-00210 and shall be Ram-Nek by K.T. Snyder Company, Inc., Kent Seal, Conseal, or approved equal.

1. Installation of gaskets - Apply primer per manufacturer's recommendations to clean, dry joint surface (both tongue and groove) and allow to dry. Remove the paper wrapper from one side only of the two-piece wrapper on the gasket. The outside paper will protect the gasket and assure against stretching. Before setting the manhole section in the trench, attach the plastic gasket strips end-to-end to the tongue and groove of each joint, forming a continuous gasket around the entire circumference of the manhole joint.
2. Handling of barrel sections after the plastic gasket has been affixed shall be carefully controlled to avoid bumping the gasket and thus displacing it or contaminating it with dirt or other foreign material. Any gaskets disturbed shall be removed and replaced if damaged and repositioned if displaced.
3. Care shall be taken to properly align the manhole section with the previously set section before it is lowered into position.
4. During cold or wet weather, pass direct heat over the concrete joint surface lightly until ice, frost and moisture are removed and the surface to be primed is dry and warm immediately before application of primer. Direct heat shall also be passed over plastic gasket strips immediately prior to attaching them to joint surfaces and immediately prior to insertion of tongue into groove.

   Temporary covers of three eighths (3/8) of an inch steel plate of sufficient size to adequately cover the opening shall be placed on the cone or manhole flat top until the street structural section is complete. The manhole casting shall then be installed. Suitably located ribs of the temporary covers shall be welded to the underside of the cover to hold it in place during any grading operations.

   The throat of the manhole shall be made of precast concrete rings of the proper inside diameter. The maximum depth permitted between the top of the manhole cone, or bottom edge of manhole flat top access hole and the top of the manhole frame shall be eighteen (18) inches or less of rings and manhole frame.

   When adjusting the manhole frame and cover to grade, the frame shall be wired to temporary wooden supports, two (2) inches x four (4) inches minimum size and of sufficient length to span the excavation and the throat completed to the right level. Whenever the space between the bottom of the frame and the top of a ring is less than three (3) inches, the void may be filled with concrete, poured against a suitable form on the inside of the structure. Said space shall not be less than 1 inch without City approval.

When adjusting an existing manhole to grade and the total depth of the throat from the top of the frame to the bottom of the throat exceeds eighteen (18) inches, the upper portion of the manhole shall be removed to the first full-size manhole section. The upper portion shall then be reconstructed as outlined above.

When connecting to an existing manhole, first the inter channel in the manhole base shall be reconstructed with a channel to meet the existing flow lines. Then cut out an opening in the wall of the manhole and install a Kor-N-Seal or approved equal product to attach the new pipe. Insert the end of the pipe through the opening. The end of the pipe shall be fitted with an elastomeric coupling with a steel band and a rubber gasket water stop. The opening around the pipe shall then be packed with a stiff mix of thoroughly compacted cement mortar composed of one (1) part type II Portland Cement and three (3) parts clean sand. Connections shall be checked for water tightness.

Before any work is started on adjusting or repairing a manhole, the channels in the base shall be covered with strips of wood and the entire base covered with a heavy piece of canvas. This cover shall be kept in place during all work. Upon completion of the work, the wood strips and the canvas shall be removed from the manhole allowing no debris to fall in or remain in the manhole.

Eccentric manholes shall be constructed perpendicular to flow unless otherwise directed by the City Engineer.

Sanitary sewer manholes shall be subject to a vacuum test as noted in Section 14.03 D.1. below, prior to approval.

Cast-In-Place Manhole Base - The cast-in-place concrete base shall be 4,000-psi minimum concrete. It shall rest on a minimum of six (6) inches of bedding material and shall be of the dimensions shown on the Standard Details.

If vertical and horizontal alignment of sewer lines are consistent through manholes, the pipe may be laid continuously through the manhole location. For new construction, joints in the pipe shall be placed two and a half (2.5) feet beyond each side of the manhole base. After the manhole base and precast sections have been placed and sufficient time has elapsed to allow all concrete and grout to set, as determined by the City Inspector, the top half of the pipe within the manhole shall be carefully cut off and the sides mortared. For placement of a cast in place manhole over an existing sewer main, under no circumstances shall a pipe joint be permitted within the manhole.

All channels so formed shall be checked with a template and shall form a smooth flowing channel at all flow depths.

D. CLEANING, INSPECTION, AND TESTING OF SEWER LINES AND APPURTENANCES - All leakage tests shall be completed and approved after City acceptance of street

subgrade and/or trench backfill except for the manhole vacuum test and manhole liner testing. Any excavation required for testing or repairs shall be backfilled with aggregate base compacted to ninety-five (95) percent relative compaction.

1. Cleaning And Flushing - Cleaning and flushing for acceptance shall occur after all manholes and cleanouts have been raised to grade and finished and lateral services are installed. unless approved otherwise by the City Engineer. Pipeline cleaning, including laterals, shall be performed prior to CCTV inspection and all sewer system testing work. The designated manhole/pipe section(s) shall be cleaned with a minimum two (2) passes using hydraulicly propelled, high-velocity jet or mechanically powered cleaning equipment (Hydroflusher or Hydrovactor), Newly constructed pipelines and service laterals shall be cleaned, removing all foreign materials from all improvements. Pipelines to be inspected for warranty acceptance shall be cleaned to remove all foreign material. Larger pipelines that have minor deposits in the pipe shall be cleaned to restore carrying capacity to a minimum of ninety-five (95) percent of original capacity, Grease accumulation in sanitary sewer pipelines shall be removed so cracks and breaks can be observed during the CCTV inspection. Cleaning shall be performed before inspection, but not more than forty-eight (48) hours before the CCTV inspection of the pipeline is started; however, water shall always be introduced into the pipe immediately prior to the CCTV inspection. All debris and loose material shall be removed by vacuum equipment at the next downstream manhole structure. Transported to a disposal site and disposed of lawfully.

   Sewer hydro cleaning equipment of high-velocity type (hydroflusher or hydrovactor) shall be truck or trailer mounted. The equipment shall have a minimum of six hundred (600) feet of high-pressure hose with a selection of cleaning nozzles. The equipment shall be capable of supplying water at sixty (60) gallons per minute at a minimum working pressure of one thousand two hundred (1,200) pounds per square inch (psi) and regulated to note exceed a maximum pressure of one thousand five hundred (1,500) psi. The nozzles shall be capable of producing a scouring action for any pipeline size scheduled for cleaning. All controls shall be located so that the equipment can be operated above ground at minimum interference to existing traffic and/or danger to the operator. Due to possible accessibility constraints, additional lengths of high-pressure hose may be required. Where accessibility constraints exist, reduced flow and pressure may be used subject to the approval of the City. However, the performance criteria for cleaning of the manhole section shall remain unchanged.

   It is recognized that there are some conditions such as a broken pipe and blockages that prevent cleaning from being completed or where additional damage would result if cleaning were attempted or continued. If cleaning of an entire section cannot be successfully performed from one manhole, the equipment shall be set up on another manhole and cleaning be attempted. If again, successful cleaning

cannot be performed, or the equipment fails to traverse the entire manhole section, it shall be assumed that a major blockage exists, work shall be stopped on the manhole segment in question, and the City shall be immediately notified. Where a broken pipe or a major blockage is suspected, the Contractor shall not proceed with additional cleaning except at their own risk, without the specific written direction of the City.

When hydraulic cleaning equipment is used, the Contractor shall be responsible to plan and control cleaning operations to prevent flooding of the sewers or storm drains and public or private property, If requested, and after obtaining prior approval from the City Engineer, a movable dam-type equipment shall be constructed in such a way that a portion of the dam may be collapsed at any time during the cleaning operation to protect against flooding of the sewer or storm drain. Movable dam equipment shall be equal in diameter to the pipe being cleaned and provide a flexible scraper around the outer periphery to ensure removal of grease.

Whenever lines to be cleaned show evidence of being more than one half (1/2) filled with solids, alternative methods, (such as a power rodder) shall be utilized to remove most of the material before hydraulic equipment is brought into use for finishing the cleaning of the pipeline. Power Rodding machines shall be continuous rod-type capable of holding one thousand (1,000) lineal feet of rod. The machine shall have a positive rod drive to produce two thousand (2,000) pound rod pull. To ensure safe operations, the machine shall have a fully enclosed body and an automatic safety throw-clutch and other safety equipment required by law. Rodding machines shall be equipped with proper tools for all types of cleaning of the sizes of pipe in which work is to be performed. On completion of the rodding operations, hydraulically propelled or high-velocity cleaning equipment shall be used to ensure that all sand, grease, and other fine materials have been removed. Satisfactory precautions shall be taken to the pipelines from damage that might be inflicted by the improper use of cleaning equipment.

After cleaning the pipeline, the Contractor shall spray or washdown the interior walls of each manhole with a nozzle or gun using approximately five hundred (500) psi of water.

When the Contractor has been authorized to take water from fire hydrants, including obtaining the necessary City permits:

a. Water use shall be conserved and not used unnecessarily.
b. Only approved fire hydrants, backflow preventors, hydrant wrenches, and shut off valves shall be used.
c. A visible air gap shall be maintained between the discharge of the fire hose and the Contractor/s storage tank.
d. No fire hydrant shall be obstructed except to refill empty water tanks.

All sludge, dirt, rocks, sand, grease and other solids or semisolid materials resulting from all types of cleaning operations shall be trapped and removed at the downstream manhole of the sections being cleaned by vacuum equipment. Passing materials from manhole section to manhole section, which could cause line stoppage, accumulation of sand in wet wells or damage to pumping equipment shall not be permitted. All solid and semisolid material removed from the pipe system during the cleaning operation shall be removed from the site and disposed in a lawful manner.

Final acceptance of the cleaning work will be made after the CCTV inspection has been reviewed and accepted. If additional foreign material is found during the CCTV inspection process, such sections of pipe shall be recleaned and reinspected by CCTV at the direction of the City Engineer.

2. Manhole Vacuum Test - All sewer manholes shall pass a vacuum test. The vacuum test shall be performed by the Contractor after installation of the manhole but prior to placement of trench backfill. All joint surfaces both inside and outside of the manhole shall be plastered with mortar and all lift holes shall be filled with mortar. All pipes entering the manhole shall be plugged, taking care to securely brace the plug to prevent it from being drawn into the manhole. The test head shall be placed inside of the top of the cone section and the seal inflated in accordance with the manufacturer's recommendation. A vacuum of ten (10) inches of mercury shall be drawn and the vacuum pump shut off. With the valves closed, the time shall be measured for the vacuum to drop to nine (9) inches. Acceptable times are:

   45+ seconds for 36-inch diameter manhole
   60+ seconds for 48-inch diameter manhole
   75+ seconds for 60-inch diameter manhole
   90+ seconds for 72-inch diameter manhole

   If a manhole fails the vacuum test, repairs shall be made with mortar while the vacuum is still being drawn. Retesting shall proceed until a satisfactory test is obtained.

   All joint surfaces of precast sections and the manhole base shall be plastered with mortar both inside and outside of the manholes. All joint surfaces plastered with mortar shall be brushed to a smooth finish with a wet brush. The mortar shall be composed of one (1) part Type II Portland cement and three (3) parts clean sand. All manholes shall be watertight. If the manhole shows moisture collecting on the manhole wall or groundwater leaking or seeping through the manhole walls or pipe penetrations during the inspection and testing process, the City may require additional testing and remedial repairs at its discretion. All repairs shall be made at the sole expense of the Contractor.

3. Manhole Liner Testing - Manhole Liner Testing requirements - Liner testing shall

comply with Sections 502-5 and 502-6 of the latest edition of the "Greenbook" Standard Specifications for Public Works Construction, as published by BNi Publications, Inc.

4. Flexible Pipe Deflection Test - A deflection test shall be made by the Contractor after all flexible pipe sewer pipe is installed and cleaned and upon completion and acceptance of all trench backfill by the City. The deflection testing shall be in the presence of the City Engineer and shall be conducted by the Contractor. One hundred (100) percent of all mainline flexible sewer pipe installed shall be deflection tested for excessive vertical deflection using a pre-sized, rigid mandrel or "Go-No-Go" device approved by the City Engineer. The mandrel size shall be clearly labeled and shall be sized so as to provide a diameter of at least ninety-five (95) percent of the base internal diameter as specified in ASTM D-3034 for PVC gravity sewer pipe.

   The mandrel shall be drawn through the pipe using only the force that can be exerted by one man on the end of a rope, using no mechanical advantage. Under no circumstances shall the mandrel device be attached to the cleaning ball.

   Pipe exceeding five (5) percent deflection shall be replaced to the nearest factory joints and the pipe shall be retested with the mandrel in the presence of the City Engineer. Re-rounding or other attempts to reduce deflection beyond the allowable limit will not be acceptable. All retests for deflections shall be made at the complete expense of the Contractor.

5. Low-Pressure Air Test - After City acceptance of street subgrade, prior to paving, and acceptance of final site grading around service laterals, the Contractor shall, at the Contractor's expense, conduct a Line Acceptance Test using low-pressure air. The test shall be performed according to stated procedures in the presence of the City Engineer.

   Procedure: At least two minutes shall be allowed for the air pressure to stabilize after air is introduced into the sealed test section.

   After the stabilization period (3.5 psi minimum pressure in the pipe), the air hose from the control panel to the air supply shall be disconnected. The portion of line being tested shall be termed "Acceptable" if the time required in minutes for the pressure to decrease from three-point-five (3.5) to two-point-five (2.5) psi is not less than the time shown for the given diameters in the following table:

| Pipe Diameter in Inches | Minutes |
|---|---|
| 4 | 2.0 |
| 6 | 3.0 |
| 8 | 4.0 |
| 10 | 5.0 |
| 12 | 6.0 |

For larger diameter pipes, use the following formula. Minimum time in seconds = three hundred seventy (370) x pipe diameter in feet.

When the prevailing groundwater is above the pipe being tested, air pressure shall be increased by forty-three hundredths (0.43) psi for each foot of water table above the invert of the pipe.

If the installation fails to meet this requirement, the Contractor shall, at his own expense, determine the source of leakage. He shall then repair or replace all defective materials and/or workmanship and perform the air test as many times as necessary to achieve an acceptable test. All repairs and/or replacements and retests shall be at the Contractor's expense.

The pressure gauge used shall be supplied by the Contractor and shall have a minimum division of one tenth (0.10) psi and shall have an accuracy to four one-hundredths (0.04) psi. Accuracy and calibration of the gauge shall be certified by a reliable testing firm.

Safety Note: The air test may be dangerous if, because of ignorance or carelessness, a line is improperly prepared. It is extremely important that the various plugs be installed and braced in such a way as to prevent blowouts. No one shall be allowed in the manholes during testing. Plugs shall not be removed until all air pressure is completely relieved.

6. Closed Circuit Television (CCTV) Inspection Of Pipeline Systems - Prior to acceptance of any sanitary sewer line by the City, all four-inch and larger sewer lines shall be inspected internally by video inspection as outlined below at the Contractor's expense.
   a. General
      i. Standards - Unless otherwise directed or approved by the Engineer, CCTV recording performed for acceptance of new pipelines shall conform to the requirements herein. Submit one (1) electronic copy of the CCTV video, database, and report on a portable electronic data storage device for approval.
      ii. Equipment
         - Camera - The camera shall record in color. The footage read-out shall appear on screen away from the central focus of the main. A target shall precede the camera for measuring sags and offsets (size of target shall be noted within the video and on the video label). Target sizes shall be as follows, unless otherwise specified or directed by the City:

| Target Size | Pipe Size |
|---|---|
| 3/4 inch | $\leq$ 12 inches |
| 1 inch | >12 inches and $\leq$ 36 inches |
| 2 inches | >36 inches |

The focal distance shall be adjustable through a range from 6 inches to infinity. The camera shall be tractor driven with a rotating camera head suitably sized for each pipe diameter to be inspected.

iii. Recorder - The recorder shall record in digital video format using MPEG-2 technology or shall be capable of being converted to an MPEG-2 (*.mpg file format) or the latest digital video format compatible with the City's applications without the loss of video quality.

iv. Video Quality - The digital video recording shall be a high-resolution video of DVD quality with a minimum of 720 columns of pixels by 480 rows of lines (720x480) with a minimum refresh rate of 60 interlaced fields per second (60Hz or 30 frames per second) as established by the National Television Systems Committee (NTSC). Video recordings will include and be of suitable quality so that the audio and video portions will be free of electronic interference and excessive background noise.

v. Lighting - There shall be sufficient lighting to produce a clear and sharp image of the entire inside periphery of the pipe for all conditions encountered during the work. Lighting is to be adjusted according to the size of pipe. In an eight (8) inch diameter pipe with joints at five (5) foot intervals, the lighting shall allow the camera to reveal not less than three (3) consecutive joints, or up to ten (10) feet of unobstructed pipe shall be visible in the monitor picture.

vi. Locator - A locating device or other acceptable locating method shall be used to locate points of deficiencies on the ground, in green paint, or green flag.

b. Procedure

i. Timing - The Contractor shall notify the City Inspector three (3) working days prior to televising the mains to allow the Inspector the option of being on-site at time of televising.

The job is ready for CCTV inspection, only <u>after</u> placement, compaction, and acceptance of road base. The following must be completed before CCTV inspection:

- All underground facilities, utility piping, conduits, and access structures are installed, backfilled, and trench backfill compaction accepted by the City.
- All other underground facilities, utility piping, and conduit are installed and accepted. All pipelines shall be cleaned/flushed, and the final air test shall be completed and accepted by the City.

ii. Schematic - The manholes shall be uniquely identified (e.g., location stationing, letter identifier, consecutive numbering, etc.) on a plan to be provided to the Inspector and the televised segments tied to the assigned manhole reference unless otherwise approved by City. The length of

televised run shall be measured from pipe end to pipe end in one contiguous pipeline segment from manhole centerline to manhole centerline. Maximum allowable tolerance for the TV counter shall not exceed one (1) foot in one thousand (1,000) feet for location accuracy.

iii. Camera Run - The pipeline shall be flushed cleaned prior to running the TV camera. TV runs shall not be performed during cleaning operations and shall provide a clear view of the interior of the pipe and manholes. The camera is to be placed in the pipeline with the footage counter at zero (0) at the pipe end within the manhole. The camera is to travel at a speed not to exceed thirty (30) feet per minute with slowdowns at joints and services. Inspect service connections with a rotating camera head. The picture shall be clear and bright enough to allow a photograph of a section to be made. The footage counter, date, and time shall appear on screen at all times, and show the upstream and downstream manhole line segments being televised. All service laterals shall be televised and recorded from point of service cleanout or manhole to City connection on City main or manhole tap.

iv. Water Introduction - Prior to performing the TV on new construction, the Contractor must introduce enough water in the pipe segment(s) to fill all low sections and flow through the final downstream structure included within the pipe segment to be inspected. If any section of the pipe segment appears to be dry, additional water must be introduced as described above. The City Inspector will verify the adequacy of water and target size before the TV is performed. The TV must begin within thirty (30) minutes of introducing water into the pipe segment.

v. Recording - The following items are to be recorded in the first thirty (30) seconds of the recording:

- Location, subdivision name and/or project name and number
- Date and time
- Upstream and downstream manhole identifier or stationing reference number associated with the project construction plans
- Company name, Operator's name and NASSCO's PACP Certification Number
- Direction of travel (e.g., against flow, with flow)
- Pipe size
- Pipe shape
- Pipe material
- Significant comments

A label shall be affixed to the portable electronic data storage device and jacket or envelope with the above information, start-end footage, and size of target.

Each televised segment shall be preceded by the following:

- Location (MH to MH identifier or station reference number associated with the project construction plans)
- Pipe size, type of pipe, pipe shape
- Pipeline slope and flow direction
- Length of run (measured per as-built plans)
- Number of pipes entering MH and sizes
- Number of service connections

The portable electronic data storage device shall be given to the City Engineer or Construction Inspector and shall become the property of the City of West Sacramento upon completion of the televised inspection. The City reserves the right to reject any televised inspection not conforming to the requirements herein. Any televised inspection that is rejected shall be re-inspected at the Contractor's expense.

vi. Acceptance Criteria - Maximum acceptable sag for sewer pipes is three quarters (3/4) of an inch for pipes less than or equal to twelve (12) inches in diameter and one (1) inch in diameter for pipes greater than twelve (12) inches in diameter, unless otherwise specified in the Special Provisions and the Project Plans. In addition, joint separation shall not be greater than one-half (1/2) inch and chipped ends shall not be greater than one-quarter (1/4) inch. All other criteria as set by the City Standard Specifications and the Contract Documents shall apply for both sewer and storm drainpipes. Within ten (10) full working days from receipt of the digital video, database, and report, the City Inspector shall review and either approve the pipelines(s) or call for repairs. The Contractor is to be notified in writing of any deficiencies revealed by the CCTV inspection that will require repair. If the Contractor is to make repairs and wishes to review the television inspection with the City Inspector, the Contractor shall contact the City Inspector to set a time for viewing. Corrective work shall be done by the Contractor at their expense.

Those portions of the pipeline system that have been corrected shall be re-CCTV inspected, and video recorded at the Contractor's expense and the video recordings and revised reports delivered to the City Engineer.

The procedure outlined above will be repeated until all deficiencies observed by television inspection have been corrected until all efficiencies have been corrected to the complete satisfaction of the City Engineer.

vii. Report - Perform and record all CCTV inspections in accordance with the National Association of Sewer Service Companies' (NASSCO's) Pipeline Assessment Certification Program (PACP). CCTV inspections shall be conducted entirely in digital video format compatible with Granite XP

software (version 7, Granite Net or City's most current version), recorded in accordance with section 26-12, 2.b., and stored on a portable electronic data storage device.

CCTV inspection reports shall be accurate to within +/- 2 (two) feet or less of the total measured footage along the pipe from upstream end of the pipe to the downstream end of the pipe or vice versa.

Every section of the pipe (access point to access point) shall be identified on the video display. In addition to inspecting the pipe, all manholes shall be panned with the CCTV camera.

Documentation of the work shall consist of digital video recordings, the PACP CCTV Report(s), and the unmodified PACP database. The database shall contain PACP scoring for each inspection observation or defect. The documentation shall note important features, and any defects encountered. One copy of the digital video recording, inspection observation database, and report (one printed copy and one digital copy) shall be submitted to the City on a portable electronic data storage device for approval. With the submission, it shall also include the CCTV Inspection video form approved by the City filled with required information.

All CCTV video recordings and reports shall become the property of the City.

7. Final Visual Inspection - A final visual inspection will be made by the City Engineer to ensure that there is no ground water intrusion into the sanitary sewer system. If ground water intrusion is discovered by the City Engineer, corrective work shall be performed by the Contractor at his expense.
8. Connection to Existing Sanitary Sewer Systems - Temporary plugs, brick, mortar, or other approved devices or materials shall be installed on all sewer projects at points of connection to existing facilities. The plugs shall remain in place until completion of the testing as covered in Section 14.03D of these Specifications. These plugs, intended to prevent water and/or debris from the balling and flushing operation, drainage, or any other condition from entering the existing system, shall be installed and removed in the presence of the City Engineer. The system shall be cleaned prior to plug removal.

## 14.04 MEASUREMENT AND PAYMENT

A. PIPE - Payment for sanitary sewer pipe complete in place shall be per linear foot for each size pipe measured from center of manhole to center of manhole following a line parallel to the grade of the sewer or from the main sewer line wye to the end of service lateral for service laterals. Payment will include the furnishing of all labor, materials, water, tools, and equipment required to construct, test, video inspection, testing, and

complete the installation of the sewer pipe in accordance with the plans and these specifications.

Full compensation for all incidentals arising from this work shall be considered as included in the price paid per unit of measure and no further compensation shall be allowed.

B. STRUCTURES & MANHOLES - The unit of measure for payment shall be per each unit. Payment shall be made at the bid price per item for each structure complete in place and shall include but not be limited to the cost of excavation, backfill, frames, covers, plates, or reinforcing steel where required.

   Full compensation for all incidentals arising from this work shall be considered as included in the price paid per item or unit of measure and no further compensation shall be allowed.