

SECTION 12

SANITARY SEWERS

12.01 SCOPE:

These general and detailed Specifications form a part of the Contract Documents and shall govern the handling and installation of piping for gravity sewers, force mains and accessories described herein and as shown on the accompanying Plans. See Appendix B for Standard Details pertaining to this Section.

12.02 WORK INCLUDED:

- A. The Work includes furnishing all material, equipment and performing all labor to construct sewer mains and laterals as indicated on the Plans or as instructed, connecting to existing sewers, manholes and other appurtenances as may be required to complete the Work ready for operation. The lines shall be laid in the locations and to the grades shown on the Plans.
- B. The Contractor shall clear and grub as necessary, remove as much of pavement as may be necessary; excavate trenches and pits to the required dimensions; excavate bell holes; construct and maintain all bridges required for traffic control; sheet, brace and support the adjoining ground or structures where necessary; handle all drainage or groundwater, guard the site; unload, haul, distribute, and lay the pipe and fittings; connect intercepted laterals to the new sewer and plug dead ends, or rearrange other conduits, ducts, or pipes where necessary; replace all damaged drains, sewers, or other structures; backfill the trench and pits; restore roadway surfaces; remove surplus excavated material and clean the site of the Work.

12.03 MATERIALS:

A.¹ Ductile Iron Pipe Gravity and Force Mains:

Where specifically designated on the Plans or at locations determined in the field, ductile iron pipe shall be used for gravity sewers and force mains. Ductile iron pipe and fittings shall be as hereinafter specified.

Ductile iron pipe for gravity sewers shall be provided with ceramic epoxy interior lining as specified herein.. Ductile iron pipe and fittings for force mains shall have a cement mortar lining conforming to ANSI/AWWA C104/A21.4. Cutting of ductile iron pipe shall be by saw, cutter, abrasive wheel or other approved means. In no case shall ductile iron pipe be cut by burning. Marking of ductile iron pipe shall include the pressure rating, metal thickness, net weight of pipe without lining, length of pipe, name of manufacturer and letters "DI" which shall be clearly marked on each length of pipe.

1. **Ductile Iron Gravity Sewer Pipe** – Ductile iron pipe for gravity sewers shall be mechanical joint or push-on joint conforming to ASTM A746. The minimum wall thickness shall be as specified in ASTM A746 for Thickness Class 52. Extra thick ness shall be provided where required by deep cover in accordance with

¹ Section 12.03, subsections A., A.1, A.2, A.3, A.6 and C.1 Revised & adopted 1/6/03

ASTM A746, Table 12, for Type 2 laying condition.

2. **Ductile Iron Force Main Pipe**

– Ductile iron lock joint pipe shall meet the requirements of ANSI/AWWA C151/A21.51 for ductile iron pipe and may be of the bolted or boltless type suitable for 150 psi working pressure. If bolted type pipe is used, all bolts and nuts shall be Corten Steel. The minimum thickness shall be as specified in ANSI/AWWA C150/A21.50 for Thickness Class 52. Extra thickness shall be provided where required for deep cover in accordance with ANSWI/AWWA C150/A21.50, Table 12, for Type 2 laying condition.

3. **Ductile Iron Fittings** – Ductile

iron or cast iron fittings shall be designed for pressure rating of 250 psi and shall be in accordance with either ANSI/AWWA C110/A21.10 or ANSI/AWWA C153/A21.53-88.

4. **Positive Restrained Joint Pipe and Fittings** –

Positive restrained joint pipe and fittings may be used in lieu of friction restrained fittings. Positive restrained joint pipe and fittings shall be either mechanical joint or push-on joint and shall be manufacturer's standard restrained joint. They shall achieve restraint by means of a positive factory made, metal-to-metal contact and shall allow full deflection of the joint when made up.

5. **Friction Restrained Fittings** –

The following type friction

restrained fittings may be used in lieu of positive restraint:

a. Locked mechanical joint retainer glands of adequate strength to prevent movement may be used to supplement concrete backing. Locked mechanical joint retainer glands shall be ductile iron retainer glands equipped with either hardened cupped end set screws of a type which utilizes a multiple wedging action and twist-off nut to insure proper actuating of the restrained devices.

b. Friction mechanical joint restraint may be used in lieu of locked mechanical joint retainer glands. Mechanical joint restraint shall be incorporated in the design of the follower gland and shall include a restraining mechanism which, when actuated, imparts multiple wedging action against the pipe, increasing its resistance as the pressure increases. Flexibility of the joint shall be maintained after burial. Glands shall be manufactured of ductile iron conforming to ASTM A536. Restraining devices shall be of ductile iron heat treated to a minimum hardness of 370 BHN. Dimensions of the gland shall be such that it can be used with the standardized mechanical joint bell and tee-head bolts conforming to ANSI/AWWA A21 and ANSI/AWWA C153/A21, latest revision. Twist-off nuts shall be used to insure proper actuating of restraining devices. The mechanical joint restraint device shall have working pressure of at least 250 psi with a minimum safety of 2:1.

c. A gasket system utilizing stainless steel locking segments molded into the gasket may be used in lieu of mechanical joint retainer glands to achieve joint restraint for line sizes 4 inches through 12 inches.

6. **Polyethylene Sheath** – Unless otherwise indicated by soil testing, polyethylene sheath shall be installed on all ductile iron pipe. The exterior of ductile iron pipe shall be covered with a sealed polyethylene sheath in accordance with AWWA Specification C105. Polyethylene sheath shall be on the Board's list of materials and approved manufacturers.

Backfill shall be as specified elsewhere in these Specifications. Care shall be taken not to damage the polyethylene sheath during the backfill operation. Any polyethylene sheath which is damaged shall be replaced or repaired by the Contractor at no additional expense to the Owner.

B. PVC Pipe for Gravity Sewers:

Plastic pipe for gravity sewers, stacks and laterals, and fittings shall be unplasticized polyvinyl chloride (PVC), meeting or exceeding ASTM Specification D3034, latest edition, Classification SDR 35.

Pipe lengths shall not exceed 20 feet and provisions shall be made at each joint to accommodate expansion and contraction.

All pipe and fittings shall be joined by means of an integral wall bell and spigot

and sealed with a rubber gasket. This joint shall be capable of withstanding an internal hydrostatic pressure of 25 psi for 1 hour with no leakage.

In every instance where pipe enters or leaves a manhole, a fitting shall be provided which will accommodate expansion and contraction of the pipe, release strain on the pipe (caused by differential settlement between pipe and manhole) and provide a rubber ring water seal between pipe and manhole. Where indicated, fittings shall also be provided for stubouts for future connections and stubout shall be sealed with PVC plug. Fittings shall be included in the price of the manholes.

Pipe shall be retained in shipping cradles when stored along the right-of-way until pipe is ready to be laid. In no case will removal of pipe from cradles be permitted more than 24 hours in advance of placing in trench.

PVC pipe shall be installed in accordance with ASTM D2321, latest edition. If there is a conflict between the provisions of ASTM D2321 and the Project Specifications, the Project Specifications shall govern as to this conflict. Deflection of PVC pipe after installation and backfill shall not exceed 5 percent. Pipe found to be deflected more than 5 percent shall be replaced at the Contractor's expense.

All PVC sewer lines shall be tested by the Contractor and at his expense for diametric deflection using a GO-NO-GO type mandrel or other approved method. The mandrel shall have an outside diameter of not less than 95 percent of the PVC pipe inside diameter. This testing shall be accomplished prior to final acceptance, but at least 30 days after the pipe has been backfilled completely.

C. **PVC Pipe for Force Mains:**

PVC pipe for force mains shall be provided as shown on the Plans. PVC pipe shall conform to the requirements of AWWA C900, "Standard for Pressure Pipe with Cast Iron Pipe Outside Diameter." Color of PVC pipe for sewer force mains shall be brown. Pipe shall be Class 150 with a Standard Dimension Ratio of 18 or heavier. Pipe joints shall be integral bell and spigot type with rubber ring sealing gasket. The pipe bell shall be designed to be at least as strong as the pipe wall. Standard lengths shall be 20 feet except that 15 percent of total footage for a particular project may be random lengths of not less than 10 feet each. Each piece of pipe shall be tested by the manufacturer to 600 psi for a minimum of 5 seconds. The bell shall be tested with the pipe.

As an alternate to brown-colored pipe, white PVC Class 150 pipe with a Standard Dimension Ratio of 18 or heavier, and meeting or exceeding all other requirements of this section, may be used with the following additions:

- (1) For pipe sizes 2" through 4" – a one inch (1") wide continuous brown solid stripe shall be applied to the surface of the pipe 180 degrees from the normal pipe markings.
- (2) For pipe sizes 6" and larger – a three inch (3") wide continuous brown solid stripe shall be applied to the surface of the pipe 180 degrees from the normal pipe markings.
- (3) The paint used shall be manufactured by Sherwin Williams with a product designation "Bolt Brown SN 4001 Epoxy Paint" or approved equal.

(4) The pipe will be placed in the trench with the solid brown stripe visible from the top of the pipe trench.

1. **Fittings for PVC Pipe** shall be made of cast iron or ductile iron conforming to ANSI/AWWA C110/A21.10. Cast iron or ductile iron fittings shall be as specified for ductile iron pipe. Fittings shall be provided with a transition gasket specifically designed to accommodate the outside diameter of the PVC force main. Provide certified test results that fittings meet or exceed these Specifications.

Tapping saddles shall be used for insertion of corporation stops or other outlets for testing of force mains.

2. **Marking Tape for PVC Pipe** shall be provided for all PVC force mains. Marking tape shall be green with imprint "Caution: Buried Sewer Line Below", buried 6 to 12 inches above the top of the pipe. Tape shall be 3 inches wide minimum, made of an inert plastic film resistant to alkalis, acids, or other destructive chemical components likely to be encountered in soils. The pipe trench shall be backfilled to at least 6 to 12 inches above top of the pipe and the tape shall then be placed flat with imprint up. Backfill shall be carefully placed to a depth of 3 inches over tape by hand to assure that the tape is secured in place over the pipe. It is the intent of this Paragraph to provide a means of identifying and protecting force mains. Marking tape used with PVC force mains shall be

metalized so that the PVC pipe can be located using standard pipe location equipment.

CC.² Small-Diameter PVC Pipe for Force Mains (Under 4-Inch Diameter):

Small diameter polyvinyl chloride (PVC) pipe for force mains and pressure service lines from grinder station installations and septic tank effluent pumps (STEP) installations shall be provided, along with appurtenances, as shown on the Plans. PVC pipe with diameters of less than 4 inches shall be Schedule 40 pipe manufactured from Type 1, Grade 1 PVC compounds with a cell classification of 12454-B as specified in ASTM Specification D1784, latest edition. Physical dimensions and tolerances of PVC Schedule 40 pipe shall meet the requirements of ASTM Specification D1785, Latest edition. Standard lengths shall be 20 feet. Coloring of pipe shall be as per Section 12.03 entitled "Materials", Paragraph C entitled "PVC Pipe for Force Mains".

1. Joints of small diameter PVC pipe shall be solvent weld type and shall be made in a two-stop process with primer manufactured for thermoplastic piping systems and solvent cement conforming to ASTM Specification D2564, latest edition. Belled end pipe socket dimensions for solvent weld system shall conform to ASTM D2672, latest edition.
2. Fittings to be installed in conjunction with force mains and pressure service lines shall be of the same material and have joints as described in Paragraph 1 of this section. The fittings shall be designed to withstand the same pressures required for the pipe.
3. Ball Valves on small diameter force mains and pressure service lines shall be full-ported PVC, Type 1, Grade 1 ball valves with a tee handle actuator. The valves shall be of the true union type

² Section CC adopted 9/23/02

allowing removal of the valve from the line without cutting the service line. Ball valves shall have socket end connections with Teflon seats and Viton "O" rings suitable for service with domestic sewage. Port opening through ball shall be the same size as the pipe.

4. Check Valves on force mains and pressure service lines smaller than 4 inches shall be of the gravity-operated, flapper type. The check valve shall provide a full-ported passageway when open and shall introduce a friction loss of less than six (6) inches of water at a maximum rated flow. Working parts shall be made of 300 series stainless steel and fabric reinforced synthetic elastomer. A non-metallic hinge shall be an integral part of the flapper assembly providing maximum degrees of freedom for assured seating at a very low back pressure. The valve body shall be high gloss injected molded part made of PVC with hub and socket compatible with PVC solvent weld system.

D. Reinforced Concrete Pipe for Gravity Sewers:

Reinforced concrete pipe shall conform to ASTM C76 and as amplified or modified herein.

All reinforced concrete pipe having a diameter of 24 inches or larger shall have steel end rings.

Reinforced concrete pipe for cuts of 12 feet or less shall meet the requirements for design strength in accordance with latest ASTM Designation C76, Class IV, with wall thickness "B", or greater.

Reinforced concrete pipe for cuts in excess of 18 feet shall meet the requirements for design strengths in accordance with latest ASTM Designation C76, Class V, with wall thickness "B", or greater.

Pipe bedding shall be Class B as shown in the Concrete Pipe Design Manual, prepared by American Concrete Pipe Association.

Cement for all concrete pipe shall conform to ASTM Designation C150, Type II. Manufacturer's mill certificates of chemical composition shall be provided to verify that this requirement is met. A minimum of 7.5 bags of cement shall be used for each cubic yard of concrete.

Fine and coarse aggregate shall conform to the requirements of the latest ASTM Designation C33, and shall be made from 100 percent calcareous rocks (limestone). In addition to the above, and before the manufacture of any pipe, the Contractor shall submit certified affidavits and test reports showing the following for the fine and coarse aggregate:

1. Grading.
2. Soundness.
3. Abrasion.
4. Record showing the aggregates have a demonstrable service record of at least 5 years for having been used in concrete and have given a satisfactory service when exposed to conditions similar to those to be encountered.

Concrete pipe shall be furnished with joints of the round rubber gasket type using the bell and spigot design. Rubber gaskets shall conform to ASTM C443.

Absorption of the concrete pipe shall not exceed 6 percent of the dry weight.

Inspection and rejection Paragraphs 26 and 27 of the ASTM C76-65 shall

apply, except that inspection shall be at the Contractor's expense.

Basis of acceptance of pipe shall be in accordance with 3(a)(1) of ASTM C76.

Prior to final acceptance, all installed pipe shall be checked and any defects shall be repaired in an approved manner or pipe shall be removed and replaced.

Lift holes in pipe will not be permitted.

E. Polyethylene Plastic Pipe:

Polyethylene pipe shall be made from high density polyethylene resin compound which meets ASTM D1248. Pipe shall be on the Board's list of materials and approved manufacturers. Dimensions and workmanship shall conform to ASTM F714.

The polyethylene pipe shall be the nominal pipe size and dimension ratio shown on the Plans, or in the Proposal. Installation shall be in accordance with ASTM D2321 or as modified herein.

Shipping lengths of pipe shall be assembled into one continuous length at the job site by thermal butt-fusion. Fusion machine and fusion machine operator shall be approved by pipe manufacturer. The resultant joint shall be as strong as the intervening lengths.

Jointing of pipe and installation of outlets shall be in accordance with the pipe manufacturer's written recommendations. The pipe manufacturer shall provide the services of a trained representative to instruct the Contractor's forces in the proper techniques for jointing of pipe and the installation of outlets or other items.

Installation of polyethylene pipe in areas where flotation is probable whether on land or a subaqueous location

installation shall conform with manufacturer's recommendation.

Polyethylene pipe shall not be crimped in any way during construction.

Fabricated polyethylene bends shall be manufactured by pipe manufacturer. SDR of fabricated polyethylene bends shall be equal to SDR of connecting pipe.

When connecting polyethylene pipe to manholes provide a rubber ring water seal between pipe and manhole.

Deflection of polyethylene pipe after installation and backfilling shall not exceed 5 percent.

F. Encasement Pipe:

See Section 17 entitled "Encasement Pipe".

G. Interior Linings for Sewer Pipe:

1. Ceramic Epoxy Lining for Ductile Iron Pipe –

a. General – Where specified, ductile pipe shall be lined with a high build protective lining.

b. Lining Material – The material used for lining the pipe and fitting shall have a successful history of protecting pipe lines in sewer service. The material shall be a high build multi-component amine cured novalac epoxy lining. At least 20% of the volume of the material shall contain ceramic quartz pigment.

c. Application:

(1) Surface Preparation – Ductile iron pipe with existing cement mortar, bituminous or

other lining will not be suitable to receive a ceramic epoxy lining. Prior to abrasive blasting, the entire area which will receive the protective compound shall be inspected for oil, grease, etc. Any areas where oil, grease, or any substance which can be removed by solvent is present shall be solvent cleaned using the guidelines outlined in SSPC-1 Solvent Cleaning. After the surface has been made free of grease, oil, or other substances, all areas to receive the protective compounds shall be abrasive blasted using compressed air nozzles with sand or grit abrasive media. The entire surface to be lined shall be struck with the blast media so that all rust, loose oxides, etc. are removed from the surface. Only slight stains and tightly adhering annealing oxide may be left on the surface. Any area where rust reappears before coating shall be reblasted to remove all rust.

(2) Lining – After the surface preparation and within 8 hours of surface preparation, the interior of the pipe shall receive 40 mils dry film thickness of the protective lining. No lining shall take place when the substrate or ambient temperature is below 40 degrees Fahrenheit. The surface shall be dry and dust free. If flange fittings of pipe are included, the lining shall not be used on the face of the flange; however, full-face gaskets shall be used to protect the ends of the pipe. All fittings shall be lined with 40 mils of the protective lining. The protective coating shall not

be applied in the gasket grooves.

(3) Coating of Gasket and Spigot Ends – Due to the tolerances involved, the gasket area and spigot end up to 6 inches back from the end of the spigot end shall be coated with 6 mils nominal, 10 mils maximum Protecto Joint Compound or equal. This coating shall be applied by brush to ensure coverage. Care shall be taken that the coating is smooth without excess buildup in the gasket groove or on the spigot end. All materials for the gasket groove and spigot end shall be applied after the application of the lining.

(4) Number of Coats – The number of coats of lining material applied shall be as recommended by the lining manufacturer. However, in no case shall this material be applied above the dry thickness per coat recommended by the lining manufacturer in printed literature. The time between coats shall not exceed that time recommended by the lining manufacturer. No material shall be used for lining which is not indefinitely recoatable with itself without roughening of the surface.

(5) Touch-Up and Repair – An approved joint compound shall be used for touch-up or repair. Procedures shall be in accordance with manufacturer's recommendations.

d. Procedures for sealing cut ends and repairing field damaged areas of ceramic epoxy lined pipe and fittings:

(1) Remove burrs caused by field cutting of ends of handling damage and smooth out the edge of the lining if rough.

(2) Remove all traces of oil, grease, asphalt, dust, dirt, etc.

(3) Remove any damaged lining caused by field cutting operations or handling and clean any exposed metal by sanding or scraping. Sandblasting or power tool cleaning roughening is also acceptable. Any loose lining shall be removed by chiseling, cutting or scraping into well adhered lined area before patching. Overlap at least 1" of lining in the area to be repaired.

(4) With the area to be sealed or repaired absolutely clean and suitably roughened apply a coat of joint compound.

(5) Coat the entire freshly cut exposed metal surface of the cut pipe end, and overlap at least one inch of the lining with this repair material.

e. Inspection and Certification:

(1) Inspection – All Ductile Iron pipe and fitting linings shall be checked for thickness using a magnetic film thickness gauge. The thickness testing shall be done using the method outlined in SSPC-PA-2 Film Thickness Rating.

The interior lining of all pipe and fittings shall be tested for pinholes with a nondestructive 2500 volt test.

Each pipe joint and fitting shall be marked with the date of application of the lining system and with its numerical sequence of application on that date.

(2) **Certification** – The pipe or fitting manufacturer shall supply a certificate attesting to the fact that the applicator met the requirements of this specification, and that the material used was as specified, and the material was applied as required by the specification.

2. **Ceramic Epoxy Lining for Concrete Pipe** –

a. **General:** All reinforced concrete sewer pipe shall be lined with coal tar epoxy containing ceramic filler. The coal tar epoxy shall be on the Board's list of materials and approved manufacturers.

b. **Lining Compound:** The materials used for lining must meet the following minimum performance requirements:

A direct impact resistance of 100 inch-pounds as outlined in ASTM D2794 with no cracking.

An abrasion resistance of 20 liters of sand per mil as outlined in ASTM D960.

c. **Documentation:** Certified lab test results shall be submitted to the Engineer showing the compound meets the above requirements.

d. **Application:**

(1) **General** – The material shall be applied to cleaned pipe or manholes with at least 3 coats

of 7 mil minimum dry film thickness per coat. The lining shall be applied in accordance with the manufacturer's specifications

(2) **Holiday Detection** – All interior barrel surface and coated joint surface areas shall be thoroughly inspected for holidays, utilizing 67 ½ volt sponge holiday detector specifically designed for this purpose.

(3) **Thickness Inspection** – A minimum of 5 percent of the lined joints shall be inspected each day of application for thickness of the interior barrel coat by taping two thin steel coupons in each pipe section prior to the coating application.

(4) **Adhesion Testing** – In a minimum of 1 percent of the fully cured pipe, a 4-inch diameter section of the interior lining shall be properly abraded on the surface of the top of the pipe. A 1-inch diameter wood block shall be firmly adhered with an epoxy adhesive to the abraded surface of lining. A 40-pound weight shall then be attached so that the weight hangs free and applies a minimum of 50 psi tensile strength uniformly across the lining interface.

(5) **Repair** - All damaged coated areas, holidays, thickness test areas and cored areas shall be repaired in accordance with the manufacturer's recommendations.

(6) **Testing** – All testing work as specified herein shall be performed by an established and

reputable commercial testing laboratory that has been approved by the Owner. The cost of all testing is the Contractor's responsibility.

3. PVC Lining for Concrete Pipe

a. General: The work to be included under this Section of the Specifications shall consist of the supply and installation of a PVC sheet liner in reinforced concrete pipe to effectively protect the exposed concrete surfaces from corrosion. The work shall include every item of construction necessary for a complete and acceptable installation as hereinafter specified.

b. Materials:

(1) Liner – Liner shall be 0.065 inch and on the Board's list of materials and approved manufacturers.

(2) Composition – The material used in the liner and in all joint and welding strips shall be a combination of poly (vinyl chloride) resin, pigments, and plasticizers, specifically compounded to remain flexible. Poly (vinyl chloride) resin shall constitute not less than 99 percent, by weight, of the resin used in the formulation. Copolymer resins will not be permitted.

(3) Chemical Resistance – After conditioning to constant weight at 110 degrees F, tensile specimens and weight change specimens shall

be exposed to the following solutions for a period of 112 days at 77 degrees F +/- 5 degrees.

At 30-day intervals, tensile specimens and weight change specimens shall be removed from each of the chemical solutions and tested in accordance with Paragraph B(2) above. If any specimen fails to meet the 112 day requirements before completion of the 112 day exposure, the material will be subject to rejection.

| <u>Chemical Solution</u> | <u>Concentration</u> |
|---|---------------------------|
| Sulfuric Acid | 20%* |
| Sodium Hydroxide | 5% |
| Ammonium Hydroxide | 5%* |
| Nitric Acid | 1%* |
| Ferric Chloride | 1% |
| Soap | 1% |
| Detergent (linear alkyl benzoyl sulfonate or LAS) | 1% |
| Bacteriological | BOD not less than 700 ppm |

* Volumetric percentages of concentrated C.P. grade reagents.

(4) Details and Dimensions of Pipe Sized Sheets – Basic liner sheets shall be a minimum of 0.065 inch thickness. Locking extension (T-shaped) of the same material as that of the liner shall be integrally extruded with the sheet. Locking extensions shall be approximately 2.5 inches apart and shall be at least 0.375 inches high.

Pipe linings shall be supplied as pipe size sheets, fabricated by

shop-welding the basic-size sheets together. Shop welds shall be made by lapping sheets a minimum of ½ inch and applying heat and pressure to the lap to produce a continuous welded joint. Tensile strength measured across shop-welded joints measured in accordance with ASTM D412 shall be at least 2000 psi.

(5) Installation of Lining in Concrete Pipe – Installation of the lining, including preheating of sheets in cold weather and the welding of all joints, shall be done in accordance with the recommendations of the manufacturer. The coverage of the lining shall not be less than 270 degrees.

Where a pipe lateral is installed through lined concrete pipe, the seal between the lined portion and the lateral shall be made in accordance with the manufacturer's recommendations.

c. Testing: After the pipe is installed in the trench, all surfaces covered with lining, including welds, shall be tested with an approved electrical hole detector with the instrument set at 20,000 volts minimum.

All welds shall be physically tested by a nondestructive probing method. All patches over holes or repairs to the liner wherever damage has occurred shall be accomplished as specified herein.

Each welding strip will be tested by the Contractor. The welding strips shall extend 2 inches below the liner to provide a tab.

A 10-pound pull will be applied to each tab. The force will be applied normally to the face of the structure by means of a spring balance. Liner adjoining the welding strip will be held against the concrete during application of the force. The 10-pound pull will be maintained if a weld failure develops, until no further separation occurs. Defective welds will be retested after repairs have been made. Tabs shall be trimmed away neatly by the installer of the liner after the welding strip has passed inspection. Inspection shall be made within 2 days after joint has been completed in order to prevent tearing the projecting weld strip and consequent damage to the liner from equipment and materials used in or taken through the Work.

All field tests shall be witnessed by the Owner's representative.

12.04 PRECAST MANHOLE:

Precast concrete manholes shall conform to the requirements of ASTM C-478, latest edition, with a minimum wall thickness of 5 inches. Variations to these requirements are subject to approval in writing from the Owner. Every manhole is to be fully and completely built as reached with new sewer pipe and shall meet the following requirements:

- A. All aggregate shall be made from 97 percent calcareous rocks.
- B. All Portland Cement shall be Type II or Type V. All concrete shall be a minimum of a 7 bag (658 pound) mix. The maximum allowable tricalcium aluminate content of Portland Cement is 8 percent.

- C. Manholes shall be neatly and accurately built of proper materials and in a workmanlike manner. Manholes shall be smooth and free from fractures and honeycombs. Care shall be taken not to damage the manhole sections during handling and installation.
- D. The invert and bottom curves of all manholes shall be neatly and accurately built and so formed as to facilitate the entrance and flow of sewage over them.
- E. When required, a branch pipe consisting of one segment of ductile iron pipe of the required size shall be built into manholes to receive either present or future branch lines. Branch lines for future flows shall have an Engineer approved mechanical plug.
- F. The cone shaped top section shall be eccentric and the cone and riser sections shall conform to the requirements of ASTM C-478 latest edition and as hereinafter specified. The top section of manholes less than 6 feet in depth shall be flat concrete slabs and shall conform to the requirements of ASTM C-478. Basis of acceptance for flat slab tops shall be either proof of design testing or rational design calculations as described in ASTM C-478, and shall be submitted to the Engineer for review.

Both cone shaped top sections and flat slab tops shall be designed to withstand a minimum H-20 wheel loading in accordance with AASHTO requirements.
- G. The minimum nominal diameter of manholes shall be 48 inches for pipe sizes less than 24 inches. Where larger manholes are required, eccentric transition sections may be installed not less than 6 feet above the invert, except where total depth of the manhole will not permit.

- H. New manholes shall be supplied with an approved cast-in flexible manhole pipe connectors (boots) for each pipe cutout. The flexible manhole pipe connector (boot) shall meet ASTM C-923 requirements. The flexible manhole pipe connector (boot) shall be secured to incoming and outgoing pipes with a stainless steel clamp. The clamp shall be tightened to 60-inch pounds of torque or as required by the manufacturer. The connector shall be installed in the manhole wall in accordance with the manufacturer's recommendations.

Existing manholes cored for each pipe cutout shall be fitted with flexible manhole pipe connectors (boots). The flexible manhole pipe connector (boot) shall meet ASTM C-923 requirements. The flexible manhole pipe connector (boot) shall be secured to incoming and outgoing pipes with a stainless steel clamp and a stainless steel rigid adjustable expansion ring. The clamp shall be tightened to 60 inch pounds of torque or as required by the manufacturer. The connector shall be installed in the manhole wall in accordance with the manufacturer's recommendations.

Existing pipes requiring a doghouse manhole or a cast in place manhole shall be supplied with a waterstop gasket connector. The connector shall be secured to the pipe with a stainless steel clamp. The clamp shall be tightened to 60 inch pounds of torque or as required by the manufacturer. The connector shall be cast in or sealed with non-shrink grout or an approved equal. The connector shall be installed in accordance with the manufacturer's recommendations.

Connection to manhole for HDPE pipe shall be as specified in Section 20 or as directed by the Engineer.

All connectors shall be sized specifically for the pipe material, pipe size, and manhole size being used.

- I. The Contractor shall furnish and properly set in mortar to line and grade all cast iron covers and frames. Brick stacks not more than 12 inches in total height shall be used to adjust manhole covers and frames to the proper grade and shall conform to Section 12.10. Concrete adjusting ring shall have a tolerance of +/- 3/16 inch from the center of the manhole opening.
- J. Joints in riser and cone sections shall have a rubber gasket or an approved equal meeting the requirements of ASTM C-443.
- K. Manhole riser sections and cone shall have manufacturer installed steps conforming to Section 12.07.
- L. A black mastic joint sealer, included on the Board's list of materials and approved manufacturers, or an approved equal shall be placed on top of the cone section of the manhole before setting the castings to prevent infiltration.
- M. Castings shall conform to Section 12.06.
- N. Pipes entering a manhole more than 24 inches above the manhole invert shall be a drop connection.
- O. Manhole bottoms shall be either 8 inches thick cast in place concrete or integral with the lower section of riser walls as hereinafter specified.
 - 1. Poured in place bottoms shall be 8 inches thick and shall be not less than 12 inches in diameter larger than the outside section of the riser. The top of the manhole bottom shall be a minimum of 3 inches below the lowest pipe invert. The invert shall be built up with cement

grout. Special care shall be taken to assure a good seal around the manhole bottom. The joint between the bottom and walls shall be sealed on the manhole exterior with grout.

- 2. Bottoms integral with side walls shall be set on a prepared bed of not less than 2 inches of gravel, slag, crushed stone, or reef shell. The bed shall be accurately shaped to fit the manhole bottom to assure uniform bearing over the entire manhole bottom. The invert of the manhole shall be built up with cement grout as shown on the Board's standard manhole detail.
 - 3. Backfill of undercut shall not be permitted. Any undercut shall be filled with concrete with a minimum compressive strength of 4000 psi.
 - 4. Anti-Flotation Collars shall be required for all manholes unless otherwise directed by the Engineer. Anti-flotation collars shall be at least 12 inches in diameter larger than the outside sections of the riser.
- P. Where new manholes intercept existing laterals connected to existing manholes, the Contractor shall keep the lateral service, extending from the existing manhole, intact until the next adjacent section of new sewer is completed and approved. The laterals shall then be broken and fed to the new sewer and the dead end of the laterals plugged at the manhole wall.
- Q. Manholes shall be provided with an inflow dish. "Rainstopper" or an approved equal shall be installed in the manhole to prevent excessive rainwater from entering the manhole covers. The

inflow dish and components shall be manufactured of materials resistant to corrosion from atmospheres containing hydrogen sulfide and dilute sulfuric acid. The inflow dish shall allow venting of sewer gases. The inflow dish shall be stainless steel unless otherwise specified by the Engineer and shall be anchored to the manhole by a tether. Installation shall be in accordance with manufacturer recommendations and shall not impede the proper seating of the manhole cover.

R. Manholes shall be provided with “Flex-Seal” or “Cretex” or “Ring Seal” or an approved chimney seal equal. The chimney seal shall be installed in new or existing manholes to stop infiltration in the chimney area. The chimney seal shall be flexible and allow repeated vertical and horizontal movement due to traffic loading. The chimney seal shall be secured to the manhole cone. The chimney seal shall have a design life of at least 25 years. The chimney seal shall be installed in the manhole in accordance with the manufacturer’s recommendation.

S. Before installation of any Precast manholes, the following information shall be submitted and approved by the Engineer:

1. Project name and number.
2. Manhole manufacturer.
3. Manhole shop drawings including dimensions, materials, and manhole designation numbers.
4. Gasket manufacturer and specifications.
5. The name of the independent testing laboratory proposed to certify the manholes.

6. Written acknowledgment that material certification as required in Section 12.042 will be provided at project completion.

T. Failure to comply with any part of these Specifications shall be reason for rejection of the entire manhole. Any defects shall be remedied by the Contractor immediately. Any manhole section which does not meet these Specifications shall be removed from the job site. Refusal to comply with any part of these Specifications shall be reason for denial or revocation of permission to install precast manholes.

U. All new and rehabilitated manholes and manhole components shall be warranted to be free from defects in materials and workmanship for a period of five (5) years from the date of project acceptance. Should a defect occur during this five (5) year period that is attributable to the installation or materials, then this defect shall be repaired within four (4) weeks from the date of defect notification to the Contractor at no additional cost to the Owner.

12.041 BRICK MANHOLE:

In general, brick manholes shall not be permitted. Where brick manholes are desired, complete material and construction details shall be submitted to the Engineer for approval.

12.042 MANHOLE TESTING:

A. Laboratory Testing:

1. Testing of manhole sections shall be performed in accordance with ASTM C-478, latest edition. Testing shall be performed by an Engineer approved independent testing laboratory. The services of a testing laboratory shall be acquired by the manhole supplier to test and stencil each manhole section. The cost of the testing shall be borne by the

manhole supplier. The stencil shall be a certification by the testing laboratory that the manhole section was constructed in compliance with the Board's Standard Specifications for Precast manholes. The stencil shall be a minimum 8.5 in. x 11 in. in size with letters no smaller than 3/4 inch high, and painted with permanent paint. The stencil shall be located on the interior of each manhole section. The top of the stencil shall be no more than 6 inches below the top of each precast section. The color of the stencil lettering shall be safety orange. The stencil shall be legible and include the following:

**(TESTING LABORATORY NAME)
(IDENTIFICATION NO. OF
INSPECTOR)
CERTIFIES THIS MH SECTION
COMPLIES WITH MAWSS STD
SPECIFICATION SECTION 12.04
INSPECTED (MONTH/YEAR)**

2. Manholes shall be inspected and certified by the supplier's testing laboratory at the supplier's warehouse. Only in emergency situations shall the manholes be inspected and certified by the manhole supplier's testing laboratory in the field. Manholes shall not be installed by the Contractor unless the certification is stenciled on the interior of each manhole section. Manholes shall not be certified after installation. Manholes physically damaged during shipment will not be accepted.

3. The manhole supplier shall rotate the testing laboratories it uses for the inspections discussed herein. No single testing laboratory shall be used for more than six months per year for inspecting manholes.

4. The manhole supplier shall obtain a letter of certification from the aggregate supplier that 97% calcareous aggregate is being provided for the production of

manholes. The aggregate supplier shall furnish this letter at least quarterly to the manhole supplier. The manhole supplier shall furnish a letter certifying that this same calcareous aggregate is being used in the production of the manholes being furnished.

5. The manhole supplier shall obtain a letter of certification from the cement supplier indicating that Type II or Type V cement is being provided for the production of manholes. The cement supplier shall furnish this Type II or Type V cement certification letter at least quarterly to the manhole supplier.

6. The manhole supplier shall furnish to the Engineer a document at the completion of each project that states the following:

- a. The project name.
- b. A summary of manholes provided that includes the diameter, number, and location of each manhole.
- c. The name of the independent testing laboratory(ies) that certified the manholes.
- d. The most recent documentation from the aggregate supplier showing that 97% calcareous aggregate was supplied for the manufacture of these manholes.
- e. Certification from the manhole supplier that the aggregate in item (d) is the same used in producing the manholes.
- f. The most recent documentation from the cement supplier showing that Type II or Type V cement was supplied for the manufacture of these manholes.

- g. Certification that all concrete cylinder breaks made during the manufacture of the supplied manholes successfully passed established compressive strength requirements.

Documentation “a” through “g” above, shall also be provided to developers and other organizations building sanitary sewer systems with the intention of requesting acceptance of said systems by the Board. This documentation shall be provided to developers or other sewer constructors so that they may submit the documentation to the Engineer for verification.

The manhole supplier shall provide documentation “a” through “g” to the Board on a quarterly basis. This documentation shall be for all manholes furnished directly to the Board during the 3 month period preceding the report.

The Board will not accept projects for which the above documentation cannot be furnished by the sewer constructor’s representative. It shall be the responsibility of the sewer constructor’s representative to obtain said documentation from the manhole supplier and furnish it to the Board prior to the acceptance of the facilities by the Board. The manhole supplier shall maintain the above documentation for a minimum period of three years from the date of the documentation transmittal.

B. Vacuum Testing:

- 1. All new and rehabilitated manholes shall be tested by the Contractor using the vacuum test method, by following the manufacturer’s recommendations for proper and safe procedures. Vacuum testing of manholes and structures shall be performed after curing of linings. Any leakage in the manhole or structure, before, during, or after the test shall be repaired by the Contractor for no

additional compensation from the Board.

- 2. All pipes for vacuum testing entering the manhole shall be installed at the top access point of the manhole. A vacuum of 10 inches of mercury (Hg) (5.0 psi) shall be measured for the vacuum to drop to 9 inches of mercury (Hg) (4.5 psi). Manholes will be considered to have failed the vacuum test if the time to drop 1 inch of mercury is less than the limits shown in the following table:

Vacuum Test Timetable

| Depth – feet | <u>Manhole Diameter – Inches</u> | | | |
|--------------|----------------------------------|-----------|-----------|-----------|
| | 48 inches | 60 inches | 72 inches | 96 inches |
| 4 | 10 sec | 13 sec | 16 sec | 19 sec |
| 8 | 20 sec | 26 sec | 32 sec | 38 sec |
| 12 | 30 sec | 39 sec | 48 sec | 57 sec |
| 16 | 40 sec | 52 sec | 64 sec | 76 sec |
| 20 | 50 sec | 65 sec | 80 sec | 95 sec |
| + Each 2’ | +5 sec | +6.5 sec | +8.0 sec | +9.5 sec |

- 3. Manhole depths shall be rounded to the nearest foot. Intermediate values shall be interpolated. For depths above 20 feet, add the values listed in the last line of the table for every 2 feet of additional depth.

- 4. If the manhole or structure fails the vacuum test, the Contractor shall perform additional repairs and repeat the test procedures until satisfactory results are obtained.

- 5. After the manhole installation and/or rehabilitation work has been completed, the manhole shall be visually inspected by the Contractor in the presence of the Engineer and the work shall be accepted if found satisfactory to the Engineer. The finished surface shall be free of blisters, “runs” or “sags” or other

indications of uneven lining thickness. NO EVIDENCE OF VISIBLE LEAKS SHALL BE ALLOWED.

6. The Contractor shall furnish to the Owner documentation showing the results of the vacuum test for each manhole.

7. All new and rehabilitated manholes may be retested 11 months after the manholes were installed or rehabilitated and must pass the above vacuum test requirements.

12.05 LINING FOR PRECAST MANHOLES:

A. Materials:

1. **General** - All materials incorporated in the work shall be delivered to the work site in new, unopened containers bearing the label of the supplier. The containers shall be handled and stored in compliance with the supplier's recommendations, and in a manner as to adequately protect the contents from damage, deterioration or contamination.

2.³ **Ceramic Epoxy Lining** - The materials, installation, and testing used for lining precast manholes with ceramic epoxy shall be as specified in Section 12.03.G.2 entitled "Ceramic Epoxy Lining for Concrete Pipe."

3. **Urethane-Based Lining** - The materials, installation, and testing used for lining precast manholes with a urethane-based material shall be as specified in Section 19, Rehabilitation of Manholes, with the following exceptions and additional requirements.

a. All foreign materials shall be removed from the manholes walls and bench using means and methods as necessary

³ 12.05, subsections A.2, A.3 and A.4 revised and adopted 1/6/03.

to prepare the surface as recommended by the lining material manufacturer.

b. Surface preparation and application of urethane-based lining shall not commence until after the precast manhole has been installed and all connections have been made.

4. **Ceramic epoxy lining or urethane-based lining** for precast manholes shall be used only where specifically required on the project plans or in the proposal, or where required by the Engineer.

12.06 CASTINGS:

Cast iron frames and covers shall conform to the Plans in all essentials of design. All castings shall fit the manholes properly. All castings shall be made of clean, even grain, tough gray cast iron. The quality of iron in the castings shall conform to the current ASTM Specification A-48 for Class 30 Gray Iron Castings. Frames and covers shall weigh not less than that shown on the Plans. The castings shall be smooth, true to pattern and free from projections, sand holes or defects and shall properly fit the manhole opening. The portion of the frame and cover which forms the cover seal shall be machined so that no rocking of the cover is possible. The castings shall be coated with coal tar pitch varnish. The cover shall have non-penetrating pick holes. On paved streets, the frame and cover shall be set flush with and in the plane of the paved surface.

Where shown on the plans or directed by the Engineer, sealed castings shall be of the bolted watertight manhole rings and covers and meet the above requirements.

12.07 MANHOLE STEPS:

Manhole steps shall be steel rods encased in polypropylene plastic and shall be of the type as manufactured by M.A. Industries, Inc., or approved equal. Steps may be type PS-1 or PS-2, for precast manholes and type PS-1-B or PS-2-B for brick manholes. Steps shall conform to the requirements of ASTM C-478. Manhole

steps shall be driven into the wet wall during manufacture to prevent each from “working loose” or “pulling out”.

12.08 DROP CONNECTIONS FOR MANHOLES:

Where indicated on the Plans or instructed in the field, drop connections shall be neatly and accurately constructed of proper materials and in a workmanlike manner, in strict accordance with the details shown on the Plans. Piping for drop connections shall be ductile iron except where noted otherwise on the Plans.

12.09 CONCRETE:

The minimum compressive strength required at 28 days is 4000 pounds per square inch. Field specimens and laboratory tests shall be made in accordance with the standards of the American Society of Testing Materials. The minimum amount of water shall be used to produce a workable mix and shall not exceed 6 U.S. gallons per sack of cement. Slump shall range between 2 and 5 inches.

12.10 BRICK:

Brick shall be clay brick meeting ASTM Specification Number C-32, Grade MS. Brick shall be nominal 2” x 4” x 8” size.

12.11 MORTAR FOR SEWER STRUCTURES:

Mortar for masonry in sewer structures shall be a 1:3 Portland Cement sand mix, provided that hydrated lime or mortar mix may be substituted for, not to exceed 10 percent by weight of the cement.

12.12 RUNNING BOARDS, SADDLE PILES AND MATS:

Running boards, saddle piles and mats shall be 2-inch pine which has been pressure treated with pentachlorophenol, C.Z.C or other suitable preservative to resist decay.

12.13 CRUSHED SLAG OR CRUSHED STONE FOUNDATION:

See Section 16 entitled “Erosion Control”, Paragraph 16.11, entitled “Crushed Slag or Crushed Stone.”

12.14 EMBEDMENT OF PVC PIPE FOR GRAVITY SEWERS:

A. Except as modified hereinafter, embedment material for PVC gravity sewer pipe shall be either Class I, II, or III material as described in ASTM D2321.

The table below shall be used in determining the material required for embedment of PVC gravity sewer pipe.

EMBEDMENT FOR PVC GRAVITY SEWER PIPES

| Pipe Depth | Bedding or Foundation | Haunching | Initial Backfill |
|-------------|-----------------------|------------------|------------------|
| 16’ or less | Cl I, II, or III | Cl I, II, or III | Cl I, II or III |

In areas where the existing material is other than as described above, and is not acceptable for use as embedment material, crushed slag or crushed stone, as hereinbefore specified shall be used. Separate payment will be made for crushed slag or crushed stone used for foundation or bedding and haunching under the items of “Crushed Slag or Crushed Stone Foundation” and “Haunching for PVC Pipe”, respectively. There will be no payment for embedment material when existing material from the excavations is used.

In areas where the pipe is below the water table or expected to be below the water table in the future, and the foundation or bedding material is Class I material, whether existing or as installed, crushed slag or crushed stone, shall be used for haunching of the pipe. Separate payment will be made for

crushed slag or crushed stone used for haunching of the pipe under the item of "Haunching for PVC Pipe."

B. Embedment materials listed here include a number of processed materials plus the soil types listed under the USGS Soil Classification System (FHA Bulletin No. 373). These materials are grouped into 5 broad categories according to the suitability for this application:

1. Class I – Angular, 6 to 40 mm (1/4 to 1-1/2 inch), graded stone, including a number of fill materials that have regional significance such as crushed slag, crushed stone and crushed shells are included in this class.
2. Class II – Coarse sands and gravels with maximum particle size of 40 mm (1-1/2 inch), including variously graded sands and gravels containing small percentages of fines, generally granular and non-cohesive, either wet or dry. Soil Type GW, GP, SW, SP are included in this class.
3. Class III – Fine sand and clayey gravels, including fine sands, sand-clay mixtures and gravel-clay mixtures. Soil Types GM, GC, SM and SC are included in this class.
4. Class IV – Silt, silty clays and clays, including inorganic clays and silts of medium to high plasticity and liquid limits. Soil Types MH, ML, CH and CL are included in this class. These materials are not acceptable for bedding, haunching, or initial backfill.
5. Class V - This class includes the organic soils OL, OH, and PT as well as soils containing

frozen earth, debris, rocks larger than 40 mm (1-1/2 inch) in diameter, and other foreign materials. These materials are not acceptable for bedding, haunching, or initial backfill.

12.15 EMBEDMENT OF POLYETHYLENE SEWER PIPE:

Embedment of polyethylene sewer pipe shall be used if it becomes necessary to replace a lateral where polyethylene sewer pipe liner is being installed.

Embedment material shall be Class 1 structural backfill, which shall be angular, 6 to 40 mm (1/4 to 1-1/2 inches), graded stone, including a number of fill materials that have regional significance such as coral, slag, cinders, crushed stone, and crushed shells. Embedment shall be paid for a Class 1 structural backfill for polyethylene pipe. Separate payment will be made for slag or crushed stone.

12.16 BACKFILLING:

See Section 15 entitled "Backfilling."

12.17 EROSION CONTROL:

See Section 16 entitled "Erosion and Property Control", for "Erosion and Property Control", "Clearing and Grubbing," "Topsoil," "Grassing," "Mulching," "Seeding", "Solid Sod", "Riprap", "Blanket for Riprap", "Timber Ditch Checks," "Erosion Control Netting," "Silt Fence" and "Hay Bales."

12.18 GRADE:

The grade as shown on the Plans is that of the invert and to which the Work must conform. Any variation from the grade will be deemed sufficient reason to cause the Work to be rejected and rebuilt at the Contractor's expense. The Owner reserves the right to make adjustments to the grades and slopes to fit actual field conditions.

12.19 ESTABLISHING GRADE:

The Contractor may use laser beam for establishing grade of sewer, but he shall be entirely responsible for the accuracy of the Work. If laser beam is used, the Contractor shall check the grade of sewer using a level and rod, at 50 feet to 100 feet from manhole from which pipe is being laid, and at each manhole and anytime a new set up is made in the same section.

In lieu of the laser beam, the Contractor may, at his option, have a minimum of 3 batter boards placed ahead of the pipe laying at all times not to exceed a maximum distance of 50 feet between batter boards.

The Contractor shall furnish the Engineer with a centerline cut sheet for approval prior to beginning construction on the sewer line. The cut sheet will contain data obtained by the Contractor in the field and will show station number, centerline elevation, centerline cut, hub cut, and percent of grade. Data will be obtained and shown at each 50-foot station, manhole stations, and at each point of significant change in terrain elevation.

12.20 EXCAVATION:

- A. Perform all excavation of every description and of whatever substance encountered to the depth specified on the Plans or as staked in the field.
- B. All excavated material not required for filling shall be removed from the site or otherwise satisfactorily disposed of.
- C. The trench width may vary with and depend upon the depth of trench and the nature of the excavated material encountered; but in any case shall be of ample width to permit the pipe to be laid and jointed properly and the backfill to be placed and compacted properly. The width of the trench shall be at least 12 inches greater than the nominal diameter of the pipe. The maximum clear width of trench at top of pipe shall not be more

than 36 inches greater than the pipe diameter. Where trench is for the installation of rigid pipe (i.e., concrete) the trench width at top of pipe shall not exceed a width of 1.25 times the outside diameter of the pipe plus 12 inches.

Where damage is liable to result from withdrawing sheeting, the sheeting shall be left in place only when agreed to or requested by the Board.

- D. The bottom of the trench shall be carefully graded, formed and aligned before any sewers are laid therein.
- E. Where the natural soil at the bottom of the trench makes a satisfactory foundation for the sewer, it shall be shaped to the bottom quadrant of the pipe and slightly hollowed under each bell to allow the body of the pipe to have uniform contact and support throughout its entire length.
- F. Where the bottom of the trench does not make a suitable foundation for the sewer, the trench shall be deepened and backfilled with shell, gravel, or slag and shaped as above, or the pipe shall be placed on running boards or mats.
- G. The Contractor shall have a berm at least 2 feet in width between the trench and the excavated material.
- H. The trench shall be dug to the alignment and depth required and only a minimum distance in advance of the pipe laying. The trench shall be so drained that workmen may work therein efficiently. It is essential that the discharge from pumps be led to natural drainage channels, to drains, or to sewers.
- I. In excavating streets that have been surfaced with shell, sand-clay, clay gravel or other base course, such base material shall be either stockpiled and kept separate from the earth excavated or the Contractor shall at his expense

provide new base of like kind and equal quality.

J. Excavation for manholes or other structures shall be of sufficient size to leave at least 1 foot in the clear between their outer surfaces and the embankment, or sheeting which may protect it.

K. Overcut in depths of manholes shall be backfilled with concrete. Overcut in sewer trench shall be backfilled in accordance with Section 16 entitled "Backfilling." Backfill for correcting overcut conditions shall be at the Contractor's expense.

12.21 REMOVING AND REPLACING PAVEMENT:

See Section 14 entitled "Removing and Replacing Pavement."

12.22⁴ PUMPING AND BY-PASSING:

No sewage or solids will be dumped, by-passed or allowed to overflow into streets, streams, ditches, catch basins or storm drains nor will it be allowed to "back up" upstream to such an extent that homes, businesses, etc., along the sewer are flooded.

When pumping/by-passing is required, the Contractor shall supply the necessary pumps, conduits and other equipment to divert the flow of sewage from a pumping station, manhole(s) and /or pipe segment(s) where work is to be performed. The by-pass system shall be of sufficient capacity to handle existing flows plus additional flow that may occur during periods of heavy rainfall. It is the Contractor's responsibility to design and provide an adequate size pump(s) as required to pump the existing sewer flow including low and high flow periods and peak Inflow/Infiltration flows. The contractor shall provide a spare bypass pump equal in size for each pump required for all

bypassing operations. The spare pump shall be on-site and pipe for service during all bypass pumping operations.

The Contractor will be responsible for furnishing the necessary labor and supervision to set up and operate the pumping and by-passing system. The Contractor is responsible for all maintenance of the bypass pumping system to ensure no disruption in the system. The Contractor shall provide any means necessary to provide uninterrupted service on main-line service. The Contractor shall assure that an overnight bypass will not result in an overflow event. If pumping is required on a 24-hour basis, all engines shall be equipped in a manner to keep the pump noise below a maximum of 70 dBA at a distance of 70 feet in noise sensitive areas.

All bypasses pumping pipe provided shall be in good condition. Repairs made to the bypass pumping pipe by unapproved methods including, but not limited to, "duct" tape shall be unacceptable. The Contractor shall perform leakage and pressure tests on the pipe using clean water prior to installation of the bypass pumping system. The Contractor is responsible for any sanitary sewer discharge to the surface due to hose or pipe failure. Prior to removal of the bypass pumping pipe, the Contractor shall empty all sanitary sewage into the sewer system. Any discharge from air release valves shall be contained.

Where pump discharge lines cross streets or alleys, they shall be covered with wooden or metal ramps designed and installed in such manner that they do not unreasonably impair vehicular traffic traveling said streets or alleys. The Contractor shall submit three (3) copies of a Bypass Pumping Plan to the Engineer for review prior to proceeding with bypassing operations. Bypassing operations shall not commence until a Bypass Pumping Plan has been reviewed by the Engineer. As a minimum, the Bypass Pumping Plan shall contain the following items:

A. A letter from the Owner stating the computer-modeled peak sanitary sewer

⁴ Section 12.22 Revised & adopted 4/7/03.

flow rates for the pipe segments to be bypassed,

Or

In the event that the pipe segments to be bypassed have not been included in a computer hydraulic model, calculations showing the maximum hydraulic capacity based on the existing pipe diameters and constructed slopes of the bypassed segment.

B. Documentation that verifies the bypassing pump(s) ability to convey the maximum expected sanitary sewer flow rate. This documentation shall include the following items:

1. Pump manufacturer's name, model number(s), rated capacity of pump(s), performance curves and pump motor horsepower.
2. Diameter and material of bypass piping (suction and discharge).
3. Hydraulic calculations which confirm the following:
 - a. The proposed size and number of bypassing pump(s) and related pumping facilities that adequately pump the existing sewer flow including low and high flow periods and peak Inflow/Infiltration flows.
 - b. The bypassing pump(s) and bypass pumping pipe (suction and discharge) are of sufficient capacity to overcome the head losses generated by the size, length and material type of the discharge pipe and the topography of the ground between the

pumping site and the discharge point.

4. Results from a pump drawdown test(s) performed within six (6) months of the bypass pumping operation shall be provided by the Contractor for each pump to be utilized in this Contract. The Contractor shall ensure that all pump drawdown tests are performed at capacities similar to those which will be encountered during this Contract. Documentation shall be provided including the estimated maximum length and diameter of suction and discharge piping necessary, and the difference in elevation between the pump centerline, the wetwell water surface level, and the point of discharge.

The documentation of the pump drawdown test and calculations of estimated pumping losses shall, as a minimum, include the following:

- a. Written certification that a pump test was performed and the pump was performing within the pump curve ranges and at capacities required during the bypass pumping operation.
- b. Documentation of the ability of the pump to perform within the pump curve ranges given the anticipated losses due to the following:
 - i. Difference in elevation between the pump centerline and the termination of the discharge piping at the point of discharge (or the highest point in the line)
 - ii. Length and diameter of suction piping

- iii. Length and diameter of discharge piping

C. A bypass pumping schedule consisting of the following:

1. A schematic showing the arrangement and layout of the pumping and bypassing facilities at various stages in the work
2. Manholes and sewer mains to be utilized in such work along with a schedule showing the tentative dates at which particular manholes and sewer mains will be utilized
3. A detailed drawing that shows how the discharge hose or piping will be anchored at the discharge point

D. Emergency and non-working hours telephone numbers for the Contractor's key personnel.

The Contractor shall notify the Engineer a minimum of 48-hours prior to beginning bypassing operations to allow the Engineer to inspect the pumping and bypassing facilities and verify that said facilities correspond to the reviewed Bypass Pumping Plan. Bypass pumping operations shall not commence until all pumping and bypassing facilities have been inspected and reviewed by the Engineer.

Acceptance of the Bypass Pumping Plan by the Engineer does not alleviate the Contractor from discussing and resolving with the Owner the use and arrangement of any pumping and bypassing facilities well in advance of the time of need for such work and facilities is anticipated.

The Contractor shall be responsible for any sanitary sewer overflow occurring as the result of work performed as specified in Section 10.26.

No direct payment will be made for pumping and bypassing unless specifically stated.

12.23 COUPLING OF DISSIMILAR PIPES:

Transitions for dissimilar type pipes up to 12 inch O.D. shall be made by use of a flexible coupling with an adapter bushing and stainless steel band and clamps. Transitions from dissimilar type pipes over 12 O.D. shall be made by use of approved adapters specifically designed for this purpose. Joining of dissimilar pipes with concrete collars shall not be permitted except at such places where specifically approved.

12.24 LAYING SEWER PIPE:

A. The pipes and specials shall be so laid in the trench that after the sewer is completed, the interior surface of the bottom thereof shall conform accurately to grade and alignment. Sewers shall be laid in the direction opposite to the direction of flow with spigot ends of pipe pointing down grade.

B. While the pipes and specials are being laid between adjoining manholes in each straight or working section of the sewer, a round circle of light from the finished or other end of the section shall remain constantly in plain view throughout the entire length of such section and shall show the true character and shape of the interior surface of the sewer. The same test shall be applied for each working section after the sewer is completed in all respects and before it is accepted.

C. Before being set in place, each pipe must be thoroughly cleaned and freed of all dirt.

D. The joints between the individual pipes shall in all cases be made as nearly watertight as possible.

- E. Any debris or dirt which may find entrance into the pipe in making the joint shall be removed by a suitable scraper or other approved means.
- F. Wyes or tees shall be inserted or proper opening provided in the sewer lines wherever designated. All branches thus inserted, unless connected with a lateral, shall be capped.
- G. Magnetic marker shall be used to identify the location of sewer laterals, and shall be on the Board's list of materials and approved manufacturers. Magnetic marker shall be attached to a 5/8 inch diameter steel rod extending from end of sewer lateral. "Where sewer laterals are being installed in new subdivisions, each lateral shall be marked with a 4" x 4" treated post in lieu of a magnetic marker. The posts shall be placed at the end of the laterals as they are installed, shall extend 2-feet from the ground, and shall be painted green."
- H. In sewers over 8 feet in depth, or whenever instructed, PVC stacks shall be carried up from the tee or wye connection at an angle of 45 degrees with the vertical, and the end shall terminate within 4 feet of the ground surface. Where laterals are called for on the Plans, or instructed by the Owner, they shall be laid to the right-of-way line or as the Owner may direct. The ends of the stacks or laterals shall be closed with covers as specified for wye branches.
- I. Whenever pipe laying is stopped for the night or for any other cause, the end of the pipe shall be securely closed with a stopper to prevent the entrance of water, mud, or other obstructing matter, and shall be secured in such manner as to prevent the end pipe from being dislodged by sliding or other movement of the backfilling.

- J. No pipe shall be laid in water, or when the trench conditions or weather is unsuitable for such work. The Contractor shall remove any water which may be found or may accumulate in the trenches and shall perform all work necessary to keep them clear of water while the foundations are being laid, the masonry being constructed, or pipe laying is in progress. Such water removal shall be accomplished by means of a well point system or other approved means. Comprehensive plans for dewatering operations, if used, shall be submitted prior to installation. No extra payment will be made for dewatering.
- K. Wherever house laterals are intercepted by the excavation for the new sewer, connection shall be maintained temporarily to the old sewer until the particular section of new sewer is completed and tested, then the house lateral shall be broken and reconnected to the new sewer through a wye, tee or opening which shall have been placed in the sewer for that purpose.
- L. After each pipe is laid, it shall be partly backfilled and made secure before the next joint is laid.
- M. Workmen shall not walk or stand upon the newly laid pipe until the necessary backfill has been placed and tamped to prevent the displacement of the pipe.

12.25 BRACING:

See Section 7 entitled "Legal Relations and Responsibility to Public", Paragraph entitled "Bracing".

12.26 CREEK CROSSINGS:

Creek crossings shall be constructed in accordance with the details shown on the Plans. Except as hereinafter set forth, all preceding paragraphs shall govern this work.

A. The width of trench in the creek bed or across drains shall be 5 feet wider than out-to-out width of all pipes. This bottom shall be cleared of rocks, stumps, or other obstructions, and shall be reasonably smooth and level and to the elevations shown. It will be permissible to pre-assemble and lay the individual lines in 1 piece, provided the trench is shaped in such a manner that the pipe bears full length on the bottom.

B. The section of lines in the creek bed or across drains shall be backfilled in layers not exceeding 1 foot in depth and shall be spaded or rodded around and between pipes as the backfilling progresses. Backfill shall be brought flush with the bottom of the creek bed. Rocks or boulders shall not be used in the backfill.

C.⁵ Timber pile pipe support structures shall be constructed as specified herein in areas designated by the Owner.

1. Materials: All timber pile pipe support structure components shall comply with all applicable American Wood Preservers Association (AWPA) standards and Use Categories (UC) for preservative treatment by pressure processes, including but not limited to the following:

Standard C1 – All Timber Products – Preservative Treatment by Pressure Process

Standard C2 - Lumber and Timber for Salt Water Use Only

Standard C3 – Piles

Standard C14 – Wood for Highway Construction

Standard C18 – Wood for Marine Construction

⁵ Section 12.26, C - Revised & adopted 6/7/04.

Standard P5- Waterborne Preservatives

Standard M4 – Care of Preservative – Treated Wood Products

Use Categories 4B, 4C and 5C

The minimum preservative retentions per AWPA standards for southern pine timber structure members shall be as follows:

| Product / Application | Waterborne Preservatives – Retention Assay of Treated Wood – lbs/cu.ft. | | | | | | |
|--|---|--|-------------------------------------|------------------------------|-------------------------------|--|------------------------|
| | Chromated Copper Arsenate (CCA) | Alk Copper Quat – Type C (ACQ-C), Am. Copper Quat – Type D (ACQ-D) | Ammon. Copper Quat – Type B (ACQ-B) | Copper Azole – Type B (CA-B) | Copper Azole – Type A (CBA-A) | Ammoniacal copper Zinc Arsenate (ACZA) | AWPA Use Category (UC) |
| <u>Piles</u> Land or Freshwater Use - | 0.80 | NR | NR | NR | NR | 0.80 | UC4C |
| Marine Use- | 1.0 ¹ | NR | NR | NR | NR | 1.0 ¹ | UC5C |
| <u>Structural Cross Members</u> Land or Freshwater Use- | 0.60 | 0.60 | 0.60 | 0.31 | 0.61 | 0.60 | UC4B |
| Saltwater Use- | 2.5 | NR | NR | NR | NR | 2.50 | UC5 |
| NR – Not Recommended, ¹ Dual treatment – First treatment to retention indicated, second treatment with 20 lb/ft ³ of Creosote or Creosote solution | | | | | | | |

In accordance with AWPA Standard M4, all cut, bored, drilled or adzed surfaces of treated wood shall be field treated with a minimum of two applications of Copper Naphthenate preservative solution. The Copper Naphthenate solution shall contain a minimum of 2 percent copper metal. The preservative solution shall be allowed to completely soak into the wood before applying the next coat. Pile cut-off ends shall be sealed with a minimum ¼” thick trowled-on application of an asbestos-free coal tar roof cement meeting ASTM D5643,

after the final application of the preservative solution has been completely absorbed by the wood.

All bolts, nuts, washers, and other fasteners shall be factory hot-dip zinc coated per ASTM A153. Minimum required sizes and dimensions for all timber pile pipe support structure shall be as shown in Appendix M on the "Timber Pile Supports for D.I. Sanitary Sewer Pipe" plan sheet.

Elastomeric bearing material shall be placed within the saddle between the pipe and the supporting cross member and shall have a minimum width equal to the width of the cross member. The bearing material shall be minimum ½-inch thick neoprene, ALDOT Type 1, in accordance with Section 837 of the Alabama Department of Transportation Standard Specifications for Highway Construction, Latest Edition.

Piles shall be Southern Pine and shall conform to ASTM D25 and shall be unused, clean peeled, uniformly tapered, one piece from butt to tip.

2. Installation: Timber piles shall be installed to either meet or exceed the compression loads specified by the Engineer. Engineer-approved pile driving equipment shall be used. The minimum penetration for any pile shall be not less than 10 feet into natural ground or below the bottom profile for submerged areas, and shall be not less than 1/3 the length of the pile. When minimum tip elevations are specified by the Contract Documents, the Contractor shall drive piles to the specified depth that satisfies this requirement in addition to the required minimum bearing capacity. The Contractor shall be responsible for providing the lengths of piles necessary to obtain the bearing and penetration required as determined by the geotechnical engineer or from results

obtained in driving representative test piles.

12.27 INSTALLATION OF FORCE MAINS:

Force mains shall be constructed to the alignment and depth required. Force mains 16 inches and larger shall have minimum cover of 48 inches, and force mains smaller than 16 inches shall have minimum cover of 30 inches, except where otherwise noted on the Plans. The trench shall be braced and drained so that workmen may work safely therein. The width of the trench shall be at least 12 inches greater than the nominal diameter of the pipe and the maximum clear width of the trench shall be not more than 36 inches greater than the pipe diameter.

- A. Pipe Foundation: The trench shall have a flat bottom with bell holes of ample dimensions to allow jointing and so the barrel of the pipe will have a bearing for its full width.
- B. Pipe Laying: All pipe, fittings, etc., shall be lowered into the trench by means of derrick, ropes, or other suitable tools, and under no circumstances shall pipe be dropped into the trench. Any defective pipe shall be rejected.
- C. Jointing: Joints shall be installed in strict accordance with the recommendations of the pipe manufacturer.
- D. Thrust Blocks: At bends, thrust blocks of concrete of a mix not leaner than 1 cement, 2 fine aggregate and 4 coarse aggregate, having a compressive strength of not less than 3000 psi shall be installed. The blocking shall be poured against undisturbed earth.
- E. Retainer Glands: Locked mechanical joint retainer glands of adequate strength to prevent movement shall be used to

supplement concrete blocking where noted. Locked mechanical joint retainer glands shall be ductile iron retainer glands equipped with hardened, cupped end set screws. Assembly shall be designed for minimum pressure of 250 psi.

F. Backfilling: Backfilling shall be as specified in Section 15 entitled "Backfilling".

G. Testing: After the pipe has been laid and partially backfilled, all pipe, or any valved section, shall unless otherwise specified, be subjected to hydrostatic pressure of 100 psi. The pressure test shall be for at least 2 hours or until the line has been completely inspected for visible leaks, whichever is longer. Before testing, all air shall be expelled from the line. The Contractor shall make all necessary taps to expel the air and then plug all taps watertight.

Approved and suitable means shall be provided by the Contractor for determining the quantity of water lost by leakage. No pipe installation will be accepted until or unless the leakage (evaluated on a pressure basis of 100 psi) is less than 25 U.S. gallons per 24 hours per mile of pipe per inch nominal diameter of pipe. Any observed leaks shall be repaired by the Contractor whether within the prescribed limits or not.

H.⁶ Valve Boxes for Small Diameter Force Mains (Under 4-Inch Diameter): A valve box shall be provided for all direct buried shutoff valve assemblies (such as ball valve and check valve assemblies) on force mains and pressure service lines in accordance with details shown on the Plans. Valve boxes shall be cast iron and shall have a nominal 6-inch sliding type shaft. The valve box top shall be set at finished grade and shall

⁶ Added and adopted 9/23/02.

be encased with a cast-in-place concrete collar in unpaved areas. Valve boxes shall be supplied with a drop-in cast iron cover marked "PRESSURE SEWER".

The valve assembly shall be underlain with a poured-in-place concrete pad to provide support to the valve box. The valve box shall be supported above the pressure service lines by means of standard or concrete nominal 2-inch X 4-inch X 8-inch bricks as shown in the details on the Plans. The valve box shall be supported by the bricks such that the valve box does not rest directly on the pressure service line. To prevent shifting during backfilling, the bricks shall be mortared to the concrete pad.

12.28 AIR AND VACUUM VALVES FOR FORCE MAINS:

Sewage air and vacuum valves shall permit unrestricted passage of air during filling of the force main and unrestricted entry of air into the force main under vacuum condition. Float shall be stainless steel, and valve shall be designed so that the venting mechanism does not come into contact with sewage. Valves shall have NPT inlet and shall be fitted with back flushing device. The valve shall be installed in pit as shown on Plans.

Sewage air and vacuum valves, short-bodied version, shall be on the Board's list of materials and approved manufacturers.

The valve shall be fitted to a minimum 18-foot length of ductile iron force main by means of a tapping saddle, Type 304 Schedule 40 stainless steel pipe, and bronze gate valve with hand wheel. Pit shall consist of 36-inch concrete pipe with cast iron cover as shown on Plans. Cover of pit shall be flush with ground. Depth of force main shall be sufficient to install air and vacuum valve.

12.29 INFILTRATION:

Leakage into the sewer shall not exceed 100 gallons per mile of sewer per inch of inside

diameter of the sewer per 24 hours to any section between successive manholes. The amount of leakage shall be measured by a suitable weir or other device. All equipment and labor for measuring the infiltration shall be furnished by the Contractor.

If the infiltration exceeds the above specified amount, the Contractor shall make the necessary corrections to bring it within the acceptable limits. All visible leaks or points of infiltration shall be repaired even though the infiltration is below the maximum specified.

12.30 AIR TESTING OF SEWERS:

A. **General:** On all sanitary sewer lines, the Contractor shall conduct a line acceptance test using low pressure air. The air test shall be conducted after the pipe has been backfilled and the cost of air testing shall be included in other items of Work. Equipment to be used in making the test shall be specifically designed for this purpose and shall be on the Board's list of materials and approved manufacturers. The Engineer shall be advised at least 48 hours before tests are conducted.

B. **Procedures (4 Inch to 24 Inch Diameter):** All pneumatic plugs shall be seal tested before being used in the actual test installation. One length of pipe shall be laid on the ground and sealed at both ends with the pneumatic plugs to be checked. Air shall be introduced into the plugs to 25 psig. The sealed pipe shall be pressurized to 5 psig. The plugs shall hold against this pressure without bracing and without movement of the plugs out of the pipe.

After a manhole to manhole reach of pipe has been backfilled and cleaned, and the pneumatic plugs are checked by the above procedure, the plugs shall be placed in the line at each manhole and inflated to 25 psig. Low pressure air shall be introduced into this sealed line until the internal air pressure reaches 4

psig greater than the average back pressure of any groundwater that may be over the pipe. At least 2 minutes shall be allowed for the air pressure to stabilize. After the stabilization period (3.5 psig minimum pressure in the pipe), the air hose from the control panel to the air supply shall be disconnected. The test of that portion of line being tested shall be termed "Acceptable" if the time required in minutes for the pressure to decrease from 3.5 to 2.5 psig (greater than the average back pressure of any groundwater that be over the pipe) shall not be less than the time shown for the given diameters in the following table:

| <u>Pipe Dia. 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 |
| 21 | 10.0 |
| 24 | 11.5 |

In areas where groundwater is known to exist, the Contractor shall install a 1/2 inch diameter capped pipe nipple, approximately 10 inches long, through the manhole wall on top of 1 of the sewer lines entering the manhole. This shall be done at the time the sewer line is installed. Immediately prior to the performance of the Line Acceptance Test, the groundwater shall be determined by removing the pipe cap, blowing air through the pipe nipple into the ground so as to clear it, and then connecting a clear plastic tube to the nipple. The hose shall be held vertically and a measurement of the height in feet of water over the invert of the pipe shall be taken after the water has stopped rising in this plastic tube. The height in feet shall be divided by 2.3 to establish the pounds of pressure that will be added to all readings. (For example, if

the height of water is 11-1/2 feet, then the added pressure will be 5 psig. This increases the 3.5 psig to 8.5 psig, and the 2.5 psig to 7.5 psig. The allowable drop of 1 pound and the timing remain the same). Other methods for determining groundwater level may be used if approved in advance and if results are expected to be accurate in determining the groundwater level.

C. **Procedures – (30 Inch to 48 Inch Diameter):** All pneumatic plugs shall be seal tested before being used in the actual test installation. When testing sewer lines 30 inch to 48 inch only the pipe joints need to be tested. The joint tester shall be located so that the end elements (inflatable pneumatic rings or plugs) are located on both sides of the joint to be tested. Air shall then be introduced into the plugs to 50 psig. The plugs shall hold against the pressure without bracing and without movement.

The center cavity shall then be pressurized to 3.5 psig. An additional .43 psig is added to the 3.5 psig for every foot of water head above the top of the pipeline, to a maximum pressure of 15 psig. Allow pressure to stabilize for approximately 10 – 15 seconds and then turn off the pressure source. If the pressure in the cavity holds or drops less than 1 psig in 5 seconds, the joint shall be found to be acceptable. If the pressure drops over 1 psig, the joint is defective and should be repaired.

When the joint test is completed all pressure must be exhausted from the center cavity and then from the plugs. The joint tester can then be moved to the next joint.

Should the line or joint fail the pressure test, the Contractor shall, at his expense, determine the source of leakage and make repairs as necessary to eliminate leakage. Air testing shall be in addition

to infiltration tests specified in Paragraph entitled “Infiltration.”

12.31 CLEAN-UP:

See Section 10 entitled “Special Provisions”, Paragraph entitled “Clean-Up”.

12.32 INTERNAL VIDEO INSPECTION:

A. **General:**

The Contractor shall furnish the mobile television inspection studio, all television equipment and other necessary types of equipment, and all materials, electricity, labor, technicians, etc., as may be needed to perform the closed circuit television inspection of the new sewers for the purpose of documenting deficiencies and lateral locations prior to construction. A recorded verbal narrative describing pipe conditions and lateral locations shall be placed on the video recording and coincide with the written comments on the videotape. No work is authorized under this Section unless the Owner’s representative is present or has been notified 24 hours prior.

B. **Camera Requirements:**

The camera used for this inspection shall be color. The camera head shall be capable of at least 340 degrees axial rotation and 270 degrees lateral swing. The camera shall operate under a minimum scene illumination of 3 lux with a horizontal resolution of no less than 460 lines. Sufficient lighting shall be provided on the camera so that videotapes will show images that are clear and well illuminated.

C. **Inspection Procedures:**

The internal inspection shall be performed in one section of sewer at a time between adjacent manholes. The inspection shall be performed by pulling the television camera on a skid or by transporting the camera with a mechanical transport device through the section of the sewer along the axis of the pipe. The camera shall travel in the direction of flow or from the upstream manhole to the downstream manhole unless an obstruction in the pipe requires video taping upstream. The camera shall not pass through the sewer at a rate greater than ¾ ft/sec. The camera shall stop at each lateral and defect and rotate so that the lateral or defect is seen from a perpendicular field of view. Each lateral and defect shall be extensively filmed.

The sewer main shall be clean prior to televising. If the main is new or recently rehabilitated, cleaning may not be necessary. The camera operator shall take necessary precautions to prevent "hanging" the camera in the sewer main. If a camera should get stuck in the main, the contractor will be responsible for removing the camera at his expense and making any above and below ground repairs. The Contractor shall exhaust all other means to retrieve the camera before excavating for camera removal without first informing the Engineer or the Owner of the need to excavate.

The distance measured to defects and laterals shall be referenced to the center of the beginning manhole. Measurements to defects and laterals shall be accurate to within +/- 1 foot.

D. **Documentation:**

Documentation of the internal inspection results shall be as follows:

1. **Normal Internal Inspection Records:** The Contractor shall keep a daily log or record

covering the television inspection work and the information acquired therefrom. This daily log or record shall contain at least the following data:

- a. Date and Time of Inspection
- b. Contract Name and Number
- c. Name of Engineering Firm (if applicable)
- d. Name of Contractor
- e. Name of Internal Video Inspection Company (if different from Contractor)
- f. Name of Street
- g. Identification Number of Upstream and Downstream Manholes
- h. Description of the Location
- i. Direction of the Video
- j. Size, Length, Depth, and Type of Pipe
- k. Size, Depth, and Material of Manholes
- l. Distance, Position on Periphery of Pipe in Clock Orientation, Type, and Description of all Laterals and Defects
- m. Computer generated diagram of pipe and manholes which graphically provides information in "k" and "l" above
- n. An Index of Video System Codes and Abbreviations

Two copies of the log or record with the diagrams and index, typed and bound, shall be delivered to the Engineer or Owner. A copy of the log or record and a summary shall be included in the Final Project Report.

2. **Videotape:**

a. **General:** The purpose of the videotape recordings shall be to supply a continuous visual and audio record of the inspection using a VHS videocassette system. The Contractor shall fill each VHS videotape as much as practical to minimize the number of tapes. All sections of videotaped runs shall be recorded on one tape. In no event, shall a segment be divided between two tapes. Videotape runs shall be grouped in areas and submitted in sequential order relating to the area designation.

Videotape recordings shall be enclosed in vinyl plastic containers, which shall clearly indicate the date the tape was taken, the street and the designated section(s) of sewer line(s) contained on the tape, the name of the project, the name of the Contractor and the index number of the tape. The index number shall indicate the sequential number of the tape out of the total number of tapes for the project, i.e. 2 of 5.

b. **Warranty:** The Contractor warrants the accuracy and completeness of the videotape for a period of two years. If the Owner determines that the videotape does not meet the requirements as identified herein, the Contractor shall clean and re-video the line

segments for which the reporting was faulty. There shall be no discrepancies between the videotape and the written report.

12.33 CLEANING OF SEWER MAIN:

A. **General:**

The Contractor shall clean the interior of the sewer main sufficiently to allow internal video inspection to detect all deficiencies within the cleaned pipe. The mainline shall be restored to a minimum of 95% of its capacity. The Contractor shall be responsible for hauling and disposal of all debris removed during the cleaning process. All debris/sand within the pipe shall be removed from the downstream manhole of the mainline being cleaned. Washing debris and other material downstream shall not be allowed. The sewer main shall be plugged and bypassed when necessary to effectively clean the main.

The cleaning process shall also include the removal of grease and roots where necessary.

Precautions shall be taken to ensure that damage or flooding of public and private property does not occur due to the cleaning process.

B. **Light Cleaning:**

Sanitary sewer mains with less than 25% of the diameter or less of debris/sand shall require light cleaning and shall be measured on a linear foot basis.

C. **Medium Cleaning:**

Sanitary sewer mains with 25% to 50% of the diameter of debris/sand shall require medium cleaning and shall be measured on a linear foot basis.

D. **Heavy Cleaning:**

Sanitary sewer mains with greater than 50% of the diameter of debris/sand shall require heavy cleaning and shall be measured on a linear foot basis.

END OF SECTION