SECTION 33 30 00
SANITARY SEWER
Construction Specification

PART 1 GENERAL:

1.1 SUMMARY:

A. This section describes general requirements, products, and methods of execution relating to on-site sanitary sewerage excluding portions within five feet of buildings unless otherwise noted. Any work within the public right-of-way shall be constructed to the standards of the City of San Mateo; City of Redwood City, City of San Bruno, and the County of San Mateo.

1. Sanitary Sewer System, including piping and structures.

B. Contractor shall provide all labor, equipment, and materials, unless otherwise noted.

C. Related Sections:

1. Section 31 23 33 – Trenching, Backfilling, and Compacting.

2. Section 32 50 00 – Restoration Of Surfaces

San Mateo County Community College District is strongly committed to promoting sustainability throughout their campus projects. Section 01 81 13 Sustainability of the Design Standard provides guidelines and recommendations for implementing sustainability strategies. Where relevant, specific sustainability criteria is noted in this section; however, each project team should review and cross reference that front section while developing the specific project and its documentation. Each discipline shall confirm that specific performance and manufacturer information provided in the specification section is in alignment with code requirements, LEED criteria, and any other goals for sustainability.

1.2 SUBMITTALS:

A. Comply with the requirements of Section Submittal Procedures.

B. Product Data: Manufacturer's literature and data, including, where applicable, pressure rating, capacity, labels, or other markings on equipment made to the specified standards for materials, for the following:

1. Piping and fittings.

2. Jointing material.

3. Gaskets, couplings, and sleeves.

4. Precast concrete structures, including manholes.

5. Concrete mix design for sanitary structures.

6. Manhole lids and frames.

7. Steps.

8. Pipe to Structure Connection Seal

9. Clean-out boxes.

10. Lift Station Vault.

11. Pump Data.

1.3 QUALITY ASSURANCE:

A. Comply with the latest editions of the following Standards and Regulations:

1. American Concrete Pipe Association (ACPA)

a. ACPA 01-102 Concrete Pipe Handbook.

b. ACPA 01-103 Concrete Pipe Installation Manual

2. American National Standards Institute (ANSI).

B. ANSI B18.5.2.1M Metric Round Head Short Square Neck Bolts:

1. American Railway Engineering & Maintenance-of-Way Association (AREMA).

a. AREMA 1-5 Pipelines

2. American Society for Testing and Materials (ASTM)

a. A 123/A 123M Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

b. A 307 Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.

c. A 47 Ferritic Malleable Iron Castings.

d. A 47M Ferritic Malleable Iron Castings (Metric).

e. A 48 Gray Iron Castings.

f. A 48M Gray Iron Castings (Metric).

g. A 536 Ductile Iron Castings.

h. A 563 Carbon and Alloy Steel Nuts.

i. A 563M Carbon and Alloy Steel Nuts (Metric).

j. A 74 Cast Iron Soil Pipe and Fittings.

k. A 746 Ductile Iron Gravity Sewer Pipe.

l. C 12 Installing Vitrified Clay Pipe Lines.

m. C 14 Concrete Sewer, Storm Drain, and Culvert Pipe.

n. C 14M Concrete Sewer, Storm Drain, and Culvert Pipe (Metric).

o. C 150 Portland Cement.

p. C 260 Air-Entraining Admixtures for Concrete.

q. C 270 Mortar for Unit Masonry.

r. C 301 Vitrified Clay Pipe.

s. C 33 Concrete Aggregates.

t. C 361 Reinforced Concrete Low-Head Pressure Pipe.

u. C 361M Reinforced Concrete Low-Head Pressure (Metric).

v. C 425 Compression Joints for Vitrified Clay Pipe and Fittings.

w. C 443 Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.

x. C 443M Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets (Metric).

y. C 478 Precast Reinforced Concrete Manhole Sections.

z. C 478M Precast Reinforced Concrete Manhole Sections (Metric).

aa. C 494 Chemical Admixtures for Concrete.

bb. C 564 Rubber Gaskets for Cast Iron Soil Pipe and Fittings.

cc. C 700 Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated.

dd. C 76 Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.

ee. C 76M Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe (Metric).

ff. C 828 Low-Pressure Air Test of Vitrified Clay Pipe Lines

gg. C Elastomeric Joint Sealants.

hh. C 923 Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals.

ii. C 923M Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals (Metric).

jj. C 924 Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method.

kk. C 924M Testing Concrete Pipe Sewer Liner by Low-Pressure Air Test Method (Metric).

ll. C 94 Ready-Mixed Concrete.

mm. C 94/C 94M Ready-Mixed Concrete.

nn. C 94/C 94M Ready-Mixed Concrete.

oo. C 969 Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines.

pp. C 969M Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines (Metric).

qq. C 972 Compression-Recovery of Tape Sealant.

rr. C 990 Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealers.

ss. C 990M Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants (Metric).

tt. D 1784 Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.

uu. D 1785 Poly(Vinyl Chloride)(PVC) Plastic Pipe, Schedules 40, 80, and 120.

vv. D 2235 Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.

ww. D 2241 Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).

xx. D 2321 Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.

yy. D 2412 Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.

zz. D 2464 Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.

aaa. D 2466 Poly(Vinyl Chloride)(PVC) Plastic Pipe Fittings, Schedule 40.

bbb. D 2467 Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.

ccc. D 2680 Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping.

ddd. D 2751 Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings.

eee. D 2996 (2001) Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.

fff. D 2997 Centrifugally Cast "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.

ggg. D 3034 Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

hhh. D 3139 Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.

iii. D 3212 Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

jjj. D 3262 "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe.

kkk. D 3350 Polyethylene Plastics Pipe and Fittings Materials.

lll. D 3753 Glass-Fiber-Reinforced Manholes.

mmm. D 3840 "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Fittings for Non-pressure Applications.

nnn. D 4101 Propylene Injection and Extrusion Materials.

ooo. D 412 Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers – Tension.

ppp. D 4161 "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Joints Using Flexible Elastomeric Seals.

qqq. D 624 Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers.

rrr. F 1336 Poly(Vinyl Chloride) (PVC) Gasketed Sewer Fittings.

sss. F 402 Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings

ttt. F 405 Corrugated Polyethylene (PE) Tubing and Fittings.

uuu. F 477 Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

vvv. F 714 Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.

www. F 758) Smooth-Wall Poly(Vinyl Chloride) (PVC) Plastic Underdrain Systems for Highway, Airport, and Similar Drainage.

xxx. F 794 Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter

yyy. F 894 Polyethylene (PE) Large Diameter

zzz. Profile Wall Sewer and Drain Pipe.

aaaa. F 949 Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings.

3. ASME International (ASME).

   a. B1.20.1 Pipe Threads, General Purpose, Inch.

   b. B16.1 Cast Iron Pipe Flanges and Flanged Fittings.

   c. B18.2.2 Square and Hex Nuts.

   d. B18.5.2.2M Metric Round Head Square Neck Bolts.

4. American Water Works Association (AWWA).

   a. C104 Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.

   b. C105 Polyethylene Encasement for Ductile-Iron Pipe Systems.

   c. C110) Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (76 mm through 1219 mm), for Water.

   d. C111 Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

   e. C115Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges.

   f. C151 Ductile-Iron Pipe, Centrifugally Cast, for Water.

      1) C153 Ductile-Iron Compact Fittings for Water Service.

      2) C302 Reinforced Concrete Pressure Pipe, Noncylinder Type.

3) iC600 Installation of Ductile-Iron Water Mains and Their Appurtenances.

4) C606 Grooved and Shouldered Joints.

5) C900 Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Distribution.

6) M23 Manual: PVC Pipe - Design and Installation.

7) M9 Manual: Concrete Pressure Pipe.

g. California Department of Transportation (CDT): Standard Specifications:

1) Section 55:

2) Section 70:

3) Section 75:

h. Cast Iron Soil Pipe Institute (CISPI).

1) 301 Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.

2) 310 Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.

i. Uni-Bell PVC Pipe Association (UBPPA).

1) UNI-B-3 Recommended Practice for the Installation of Polyvinyl Chloride (PVC) Pressure Pipe (Nominal Diameters 4-36 Inch).

2) UNI-B-Recommended Practice for the Low-Pressure Air Testing of Installed Sewer Pipe.

j. City of San Mateo Standard Plans and Specifications.

1) American Association of State Highway and Transportation Officials (AASHTO) for H20 Loading.

2) American Concrete Institute (ACI).

3) Other authorities having jurisdiction.

C. System Description: Grades and elevations are to be established with reference to the benchmarks referenced on the Plans.

1.4 DELIVERY, STORAGE, AND HANDLING:

A. Delivery and Storage:

1. Piping: Inspect materials delivered to site for damage; store with minimum of handling. Store materials on site in enclosures or under protective coverings. Store plastic piping and jointing materials and rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes and fittings free of dirt and debris.

2. Metal Items: Check upon arrival; identify and segregate as to types, functions, and sizes. Store off the ground in a manner affording easy accessibility and not causing excessive rusting or coating with grease or other objectionable materials.

B. Handling:

1. Handle pipe, fittings, and other accessories in such manner as to ensure delivery to the trench in sound undamaged condition. When handling lined pipe, take special care not to damage linings of pipe and fittings; if lining is damaged, make satisfactory repairs. Carry, do not drag, pipe to trench.

PART 2 PRODUCTS:

2.1 PIPING:

A. Polyvinyl Chloride (PVC) Pipe: PVC pipe four inches and larger conforming to ASTM D3034, SDR 26 with bell-and-spigot type of rubber gasket joints. Bells shall be integral with pipe. Spigot end pipe with separate double hub couplings is not acceptable.

B. Vitrified Clay Pipe (VCP): VCP and fitting shall conform to ASTM C700, Extra Strength.

2.2 MANHOLES:

A. Manholes shall be pre-cast concrete of the size and shape shown on the Plans and shall conform to Sections 70-1.02H of the CDT Standard Specifications and to ASTM C478. Equivalent poured-in-place structures may be used at the Contractor's option. Concrete shall consist of Caltrans Type I/II cement.

B. Frames and covers shall be cast iron conforming to Section 55-2.03 and 75-1.02 of the CDT Standard Specifications. Manhole covers shall have the words "SANITARY SEWER" in letters not less than 2 inches cast into the cover. The clear opening for all manhole covers shall be 24 inches.

C. All interior concrete surfaces shall be coated with "Xypex Crystalline" or approved equivalent. Use of a water-resistant admix is acceptable, at contractor option.

D. Frames and lids for manholes shall be match-marked in pairs before delivery to the job site. The lids shall fit into their frames without rocking.

E. Reinforcing Bars: Reinforcing bars shall be of intermediate grade billet steel conforming to ASTM A615 and shall be of the size shown on the Standard Details or in the Plans. Bars shall be of the round deformed type, free from injurious seams, flaws, or cracks, and shall be cleaned of all rust, dirt, grease and loose scales.

F. Portland Cement Concrete: Concrete for manhole bases, inlets, and other concrete structures shall conform to the requirements of CDT Section 90 and as herein specified. The concrete shall be Class "A" containing six (6) sacks of Portland Cement per cubic yard of concrete. The grading of the combined aggregate shall conform with the CDT requirements of the three-quarter inch maximum. The consistency of the fresh aggregate shall be such that the slump does not exceed four inches, as determined by Test Method No. Calif. 520. The concrete shall have a minimum design compressive strength of 3,000 psi after 28 days.

2.3 CLEAN-OUTS:

A. Where cleanouts are located in landscaping, a box shall be provided for each clean-out. Boxes shall be pre-cast concrete with cast iron frame and cover marked "SSCO"; Christy G5 with G5C lid or approved equivalent. Where cleanouts are in hardscape, minimize the

aesthetic impact of the cleanout by eliminating the concrete box (cleanout cover flush with hardscape).

2.4 PIPE TO STRUCTURE CONNECTOR/SEAL:

A. A flexible pipe to manhole connector shall be used for all pipe penetrations to pre-cast and/or cast-in-place concrete structures.

1. The seal shall provide a flexible, positive, watertight connection between pipe and concrete wastewater structures. The connector shall assure that a seal is made between (1) the connector and the structure wall, and (2) between the connector and the pipe. The seal between the connector and the manhole wall shall be made by casting the connector integrally with the structure wall during the manufacturing process in such a manner that it will not pull out during coupling. The seal between connector and pipe will be made by way of a stainless steel take down band compressing the gasket against the outside diameter of the pipe.

The connector shall be molded from materials whose physical/chemical properties meet or exceed the physical/chemical resistant properties outlined in ASTM C-923. The connector and stainless steel hardware shall meet or exceed the performance requirements proscribed in ASTM C-923.

The connector shall be of size specifically designed for the pipe material being used and shall be installed in accordance with recommendations of the manufacturer.

B. Connectors shall be Z-LOK or G3 connectors manufactured by A-LOK Products Inc. or approved equivalent.

PART 3 EXECUTION:

3.1 PIPE INSTALLATION:

A. Pipe shall be installed in conformance with Section 31 23 33 – Trenching, Backfilling and Compacting, and manufacturer's recommendations.

B. Pipe laying:

1. No pipe shall be laid until the Geotechnical Project Manager inspects and approves the conditions of the bottom of the trench.

2. Pipe laying shall proceed "upgrade" with the spigot section of the bell-and-spigot pipe pointing in the direction of the flow.

3. Each section of pipe shall be laid true to line and grade and in such a manner as to form a close concentric joint with the adjoining pipe and to prevent sudden offsets in the flow line.

4. Pipe shall not be laid when the condition of the trench or the weather is unsuitable.

C. Debris Control:

1. The interior of the sewer pipe shall be kept clean of dirt and debris at all times. When work is not in progress, open ends of pipe and fittings shall be plugged.

2. Where clearing after laying is difficult because of small pipe size, a suitable swab or squeegee shall be kept in the pipe and bulled forward past every joint immediately after joining has been completed.

3.2 POURED-IN-PLACE CONCRETE:

A. Concrete shall be mixed in accordance with applicable provisions of Section 90 of the CDT Standard Specifications.

B. Construction of concrete structures shall conform to applicable provisions of Section 51 of the CDT Standards Specifications. Unless otherwise noted herein or in the Plans, exposed surfaces of structures shall be Class 1 surface finish.

C. Curing shall conform to applicable portions in Section 90 of CDT Standard Specifications. No pigment shall be used in curing compounds. All work shall be subject to inspection. No concrete shall be placed until the Project Manager has approved the forms and reinforcement.

D. Concrete shall not be cropped freely where reinforcing bars will cause segregation, nor shall it be dropped freely more than six feet. Spouts, elephant trunks, or other approved means shall be used to prevent segregation.

3.3 PIPELINE AIR TESTING AND FLUSHING:

A. All new sections of sanitary sewer shall be tested using the following procedures:

1. Test is conducted between two consecutive manholes, or as directed by the Project Manager.

2. The test section of the sewer shall be plugged at each end. One of the plugs used at the manhole shall be tapped and equipped for the air inlet connection for filling the line from an air compressor.

3. All service laterals, stubs, and fittings into the sewer test section shall be properly capped or plugged and carefully braced against the internal pressure to prevent air leakage by slippage and blowout.

4. Connect air hose to tapped plug selected for the air inlet. Connect the other end of the air hose to the portable air control equipment, which consists of valves and pressure gauges used to control the air entry rate into the sewer test section, and to monitor the air pressure in the pipeline. More specifically, the air control equipment includes a shut-off valve, pressure regulating valve, pressure reduction valve, and a monitoring pressure gauge having a pressure range from 0-5 psi. The gauge shall have minimum divisions of 0.10 psi and an accuracy of 0.40 psi.

5. Connect another air hose between the air compressor (or other source of compressed air) and the air control equipment. This completes the test equipment set-up. Test operations may commence.

6. Supply air to the test section slowly, filling the pipeline until a constant pressure of 3.5 psig is maintained. The air pressure must be regulated to prevent the pressure inside the pipe from exceeding 5.0 psig.

7. When constant pressure of 3.5 psig is reached, throttle the air supply to maintain the internal pressure above 3.0 psig for at least 5 minutes. This time permits the temperature of the entering air to equalize with the temperature of the pipe wall. During this stabilization period, it is advisable to check all capped and plugged fittings with a soap solution to detect any leakage at these connections. If leakage is

detected at any cap plug, release the pressure in the line and tighten all leaky caps and plugs. Start the test operation again by supplying air. When it is necessary to bleed off the air to tighten or repair a faulty plug, a new 5-minute interval must be allowed after the pipeline has been refilled.

8. After the stabilization period, adjust the air pressure to 3.5 psig and shut-off or disconnect the air supply. Observe the gauge until the air pressure reached 3.0 psig. At 3.0 psig, commence timing with a stopwatch until the pressure drops to 2.5 psig, at which time the stop watch is stopped. The time required, as shown on the stopwatch, for a pressure loss of 0.5 psig is used to compute the air loss.

9. If the time, in minutes and seconds, for the air pressure drop from 3.0 to 2.5 psi is greater than that shown in the following table for the designated pipe size, the section undergoing test shall have passed and shall be presumed to be free of defects. The test may be discontinued at any time.

10. If the time, in minutes and seconds, for the 0.5 psig drop is less than that shown in the following table for the designated pipe size, the section of the pipe shall not have passed the test; therefore, adequate repairs must be made and the line retested.

    Requirements for Air Testing

Pipe Size (in inches)	Time Minutes	Seconds
4	2	32
6	3	50
8	5	6
10	6	22
12	7	39
14	8	56
15	9	35
16	10	12
18	11	34
20	12	30

(For larger diameter pipe use the following: Minimum time in seconds = 462 X pipe diameter in feet).

11. For 8 inch and smaller pipe, only: if, during the 5 minute saturation period, pressure drops less than 0.5 psig after the initial pressurization and air is not added, the pipe section undergoing test shall have passed.

12. Multi-pipe sizes: when the sewer line undergoing test is 8 inch or larger diameter pipe and includes 4 inch or 6 inch laterals, the figures in the table for uniform sewer main sizes will not give reliable or accurate criteria for the test. Where multi-pipe sizes are to undergo the air test, the Project Manager can compute the “average” size in inches which is then multiplied by 38.2 seconds. The results will give the minimum time in seconds acceptable for a pressure drop of 0.5 psig for the “averaged” diameter pipe.

13. Adjustment Required for Groundwater:

    a. An air pressure correction is required when the ground water table is above the sewer line being tested. Under this condition, the air test pressure must be

increased .433 psi for each foot the ground water level is above the invert of the pipe.

b. Where ground water is encountered or is anticipated to be above the sewer pipe before the air testing will be conducted, the following procedure shall be implemented at the time the sewer main and manholes are constructed.

1) Install a ½ inch diameter pipe nipple (threaded one or both ends, approximately 10 inch long) through the manhole wall directly on top of one of the sewer pipes entering the manhole with threaded end of nipple extending inside the manhole.

2) Seal pipe nipple with a threaded ½ inch cap.

3) Immediately before air testing, determine the ground water level by removing the threaded cap from the nipple, blowing air through the pipe nipple to remove any obstruction, and then connecting a clear plastic tube to the pipe nipple.

4) Hold plastic tube vertically permitting water to rise in it to the groundwater level.

5) After water level has stabilized in plastic tube, measure vertical height of water, in feet, above invert of sewer pipe.

6) Determine air pressure correction, which must be added to the 3.0 psig normal starting pressure of test, by dividing the vertical height in feet by 2.31. The result gives the air pressure correction in pounds per square inch to be added.

Example: if the vertical height of water from the sewer invert to the top of the water column measures 11.55 feet, the additional air pressure required would be:

$$\frac{(11.55)}{(2.31)} = 5.0 \text{ psig}$$

Therefore, the starting pressure of the test would be 3.0 plus 5 or 8.0 psig, and the ½ pound drop becomes 7.5 psig. There is no change in the allowable drop (0.5 psig) or in the time requirements established for the basic air test.

B. After the line has passed the air test, it shall be balled and flushed with water to clean. A metal screen shall be used downstream at the point of connection to the existing system to collect and remove any rock or other debris that is flushed out during cleaning.

3.4 DEFLECTION TESTING:

A. Upon completion of work, perform a deflection test on entire length of installed plastic pipeline. Completed work includes superimposed loads adjacent to and over the pipeline, such as compacted backfill and earthwork, and does not include paving, concrete curbs and gutters, sidewalks, walkways, and landscaping.

B. Under external loads, deflection of pipe in the installed pipeline shall not exceed 4.5 percent of the average inside diameter of pipe.

C. Determine whether the allowable deflection has been exceeded by use of a pull-through device or a deflection-measuring device.

D. Pull-Through Device:

1. Provide a spherical, spheroidal, or elliptical ball, a cylinder, or circular sections fused to a common shaft.

a. Circular sections shall be so spaced on the shaft that distance from external faces of front and back sections will equal or exceed diameter of the circular section.

b. Pull-through device may also be of a design approved by the Uni-Bell Plastic Pipe Association, provided that the device meets the applicable requirements specified in this paragraph, including those for diameter of the device.

2. Ball, cylinder, or circular sections shall conform to the following:

a. A diameter, or minor diameter as applicable, of 95 percent of the average inside diameter of the pipe; tolerance of plus 0.5 percent will be permitted.

b. A homogeneous material throughout, with a density greater than 1.0 as related to water at 39.2 degrees F, and a surface Brinell hardness of not less than 150.

c. Center bored and through bolted with a ¼ inch minimum diameter steel shaft having a yield strength of not less than 70,000 pounds per square inch, with eyes or loops at each end for attaching pulling cables.

d. Each eye or loop shall be suitably backed with a flange or heavy washer such that a pull exerted on opposite end of shaft will produce compression throughout remote end.

3. Pull-Through Device:

a. Pass the pull-through device through each run of pipe, either by pulling it through or flushing it through with water.

b. If the device fails to pass freely through a pipe run, replace pipe which has the excessive deflection and completely retest in same manner and under same conditions as specified.

E. Deflection measuring Device:

1. Sensitive to 1.0 percent of the diameter of the pipe being tested and accurate to 1.0 percent of the indicated dimension.

2. Obtain approval of deflection measuring device prior to use.

F. Deflection Measuring Device Procedure:

1. Measure deflections through each run of installed pipe.

2. If deflection readings in excess of 4.5 percent of average inside diameter of pipe are obtained, retest pipe by a run from the opposite direction.

3. If retest continues to show a deflection in excess of 4.5 percent of average inside diameter of pipe, remove pipe which has excessive deflections, replace with new pipe, and completely retest in same manner and under same conditions.

G. Warranty Period Test: Pipe found to have a deflection of greater than 5 percent of average inside diameter when deflection test is performed just prior to end of 1 year warranty period shall be replaced with new pipe and tested as specified for leakage and deflection.

3.5 CLEANING:

Thoroughly clean sanitary sewer lines, manholes, cleanouts, and similar structures, of dirt, debris, and obstructions of any kind.

3.6 TELEVISION INSPECTION:

A. After completion of the pipe installation, service connections, flushing and cleaning, and prior to placement of pavement, the sewer line shall be televised with a color closed-circuit television with tilt-head camera recorded in DVD format. The original Disks and log sheets shall be provided to the Project Manager for review.

1. The following observations from television inspections will be considered defects in the construction of sewer pipelines and will require correction prior to placement of pavement:

a. Low spot (1 inch or greater - mainlines only).

b. Joint separations (3/4 inch or greater opening between pipe sections).

c. Cocked joints present in straight runs or on the wrong side of pipe curves.

d. Chips in pipe ends.

e. Cracked or damaged pipe.

f. Dropped joints.

g. Infiltration.

h. Debris or other foreign objects.

i. Other obvious deficiencies.

j. Irregular condition without logical explanation

END OF SECTION