

SECTION 13.0 SANITARY SEWER

13.01 Sanitary Sewer Pipe

All sanitary sewer pipe shall be Extra Strength Vitrified Clay, Cement Lined Cast Iron, or Cement Lined Ductile Iron.

These standard specifications for sanitary sewer pipe are intended for sizes up to and including 15" in diameter. Material and Construction Specifications for pipe sizes in excess of 15" in diameter shall require approval by the City Engineer.

It is the intent of this specification to provide pipe of the highest standard known to the trade and to provide pipe that is free from defects in workmanship and materials.

All pipe and other materials shall be first class and no used or second hand pipe or materials will be permitted.

For depths of cover over pipe three feet or less, only cast iron or ductile iron sewer pipe may be used.

For depths of cover over pipe greater than three feet, but less than twelve feet, Extra Strength Vitrified Clay, Cement Lined Cast Iron or Cement Lined Ductile Iron may be used.

For depths of cover over pipe from twelve feet to twenty-two feet, Extra Strength Vitrified Clay, Cement Lined Cast Iron or Cement Lined Ductile Iron may be used.

For depths of cover over pipe in excess of twenty-two feet, Cement Lined Cast Iron and Cement Lined Ductile Iron may be used. Thickness of CIP/DIP shall be as specified by the City Engineer.

PVC Sewer Pipe may be used as specified in Section 13.20.

Clearing

The Contractor will be required to clear, remove, or dispose of all natural, artificial, or man made obstructions to the construction as indicated on the Project Plans, or as may be evident at the time of the bidding of this Contract. The Contractor will be required to restore the construction area as close as is practical to the condition he found it. Items

in which there are "unit price" requests in the Proposal shall be priced so indicated for removal and replacement of such bid items. There will also be some incidental items in which there is not a unit bid item for, the cost for these items shall be merged in with the cost per linear foot of pipe installation and other bid unit prices as requested on the Proposal. No additional payment will be approved for items considered by the City Engineer as incidental to the construction and evident at the time of bidding.

Environmental Assessment, Corps of Engineer NW Permit 12, and 401 Certification Requirements

No fertilizer shall be applied within 10 feet of streams.

Construction corridors in Jurisdictional Wetlands shall be limited to 40 feet and must be minimized to the maximum extent practical.

Measures shall be taken to prevent live or fresh concrete from coming into contact with waters of the State until the concrete has hardened.

Restore the Wetland contours as close as practical to those existing prior to construction.

All trees, stumps, roots and other debris shall be removed and disposed of off the site by the Contractor.

Fences, mailboxes, street signs, small shrubs, driveways, roads, sidewalks, curb and gutter, walls, drainage systems, poles and cables, etc., shall be protected. If damaged they shall be restored by the Contractor to a condition equal to that existing at the date of award of the Contract. No additional payment will be allowed for this restoration.

All restoration shall be subject to the approval of the City Engineer. Existing shrubbery reset at the Owner's request will be done so with utmost care, but the Contractor will not be required to guarantee the plants to live.

Minor clearing of opened street rights-of-way is considered incidental to the installation of the sewer line. Therefore, all cost for minor clearing of open areas and open street rights-of-way shall be included in the Contractor's bid unit price per L.F. for "Sanitary Sewer Pipe" complete in place. Any large tree removal not to be considered above, will be identified on the Project Plans and also listed on the Proposal, as a separate pay item.

(G) All cost for clearing shall be included in the Contractor's bid unit price per L.F. for "Sanitary Sewer Pipe" complete in place, unless said work is specifically included on the Proposal as a separate "item" in the bid.

(G) Payment for all sanitary sewer pipe shall include all material, labor, equipment, fittings, clearing, grading, seeding, munching, tack, dewatering, shoring, trenching, bedding, trench stabilization, tamping, undercut, backfilling, required fill over and adjacent to pipe, all ditching and creek widening, testing, connecting to existing pipes, plugging, capping stubs, overhead, profit, insurance, etc., required to provide a complete project, unless such material or work is specifically included on the Proposal as a separate "item" in the bid. Payment for this item shall be based on the actual linear feet of pipe measured from center of manhole to center of manhole complete in place for the depth installed as determined by the City Engineer. The length measured for payment for sewer line pipe shall be as per the Standard Specifications including but not limited to Section 2.56.

Any open cuts approved by the City shall be restored with asphalt/concrete the same day as the disturbance began. All disturbed areas shall be seeded, mulched, and tacked no later than **seven (7) days** after the land disturbing activity started.

No payment for pipe (complete in place) shall be made until the restoration by seed, mulch, and tack of all disturbed areas and restoration of all paved drives and streets has been completed by the contractor to the satisfaction of the engineer.

For Special Conditions requiring ferrous material pipe see Section 2.12.

13.02 Extra Strength Vitrified Clay Pipe

All vitrified clay sanitary sewer pipe used shall be extra strength class pipe. Pipe shall conform to ASTM Standard Specification C 700-78A or latest subsequent revision. The pipe shall be joined using a compression sleeve manufactured to conform to ASTM C-425-82 or latest revision.

All vitrified clay sewer pipe shall be extra strength "Uptight" clay sewer pipe as manufactured by Logan Clay Products Company or an approved equal.

13.03 Cement Lined Cast Iron Sewer Pipe

Cast Iron Pipe shall be manufactured and tested in the U.S.A. and shall conform to AWWA Specification C 106 and A.S.A. Standard #A21.6 or latest revision or conform to AWWA Specification C 108 and A.S.A. Standard #A21.8 or latest revision.

Cast iron pipe shall be mechanical joint or push-on joint type. Push-on type joints shall be "Bell-Tite," "Fastite" or approved equal. All joints for cast iron pipe shall conform to the applicable dimensions and weights shown in the tables in AWWA C-106 and to ANSI A 21.11 (AWWA C -111) or latest revision. Cement linings for cast iron pipe shall conform to AWWA Specification C 104, ASA # A21.4, or latest revision.

Thickness for all Cast Iron Pipe in this contract shall be as recommended for the proposed depth of cover in the "Handbook of Cast Iron Pipe (Ductile Iron Pipe)," third edition as published by the Cast Iron Research Association, or as shown on the Project Plans, with the minimum being Class 22 for 18/40 iron strength. All Cast Iron pipe shall be for minimum working pressure of 150 PSI.

All pipe shall be clean and sound without defects that will impair their service. Repairing of defects by welding or other methods shall not be allowed.

All pipe shall have an outside petroleum asphaltic coating of approximately 1 mil thick. The coating shall be applied to the outside of all pipe and the finished coating shall be continuous, smooth, neither brittle when cold, nor sticky when exposed to the sun, and shall be strongly adherent to the pipe.

13.04 Omitted

13.05 Cement Lined Ductile Iron Sewer Pipe

Ductile Iron Pipe shall be manufactured and tested in the U.S.A. and shall conform to AWWA Specification C 151 and ANSI Standard #A21-51 or latest revision.

Cement linings for ductile iron pipe shall conform to AWWA Specification C 104.

Ductile iron pipe shall be mechanical joint or push-on joint type. Push-on joints shall be "Bell-Tite," "Fastite" or approved equal. All joints for ductile iron pipe shall conform to the applicable dimensions and weights shown in the tables in AWWA C151 and to ANSI A 21.11 (AWWA C111) or latest revision.

All pipe shall be clean and sound without defects that will impair their service. Repairing of defects by welding or other methods shall not be allowed. All pipe shall have an outside petroleum asphaltic coating of approximately 1 mil thick. The coating shall be applied to the outside of all pipe and the finished coating shall be continuous, smooth, neither brittle when cold, nor sticky when exposed to the sun, and shall be strongly adherent to the pipe.

Thickness for all Ductile Iron Pipe in this contract shall be as recommended for the proposed depth of cover in the "Handbook of Cast Iron Pipe (Ductile Iron Pipe)," third edition as published by the Cast Iron Pipe Research Association, or as shown on the Project Plans (with the minimum being Class 51).

Flanged DIP, Polyethylene Encasement - See Section 14.06

Solid Sleeves - See Section 14.09

13.06 Manholes

Manholes shall be built where shown on the plans and shall be in accordance with City Standard No. 71B-1 thru 71B-4B and these specifications. Distance between manholes shall vary as shown on the plans, but the maximum distance between manholes shall be three hundred fifty feet (350') for sewer mains and five hundred feet (500') for outfall lines.

Inverts are to have a smooth finish and shall conform to City Standard No. 71B-4 in cross-section. There shall be a minimum drop of 0.2 feet within the manhole, but in no case shall it exceed two and one half feet (2-1/2') , unless an outside drop is constructed.

Manhole walls shall be constructed to a minimum thickness of 6" when standard manhole blocks are used and to a minimum thickness of 8" when brick is used. This minimum thickness shall be increased by the width of one block or brick for manhole depths of depth over 14 feet. The bottom of the manhole shall extend a minimum of six inches (6") below the invert of the sewer. Only clay brick or standard concrete manhole block shall be used unless other

material is approved in writing by the Public Works/Utilities Director prior to construction, except that precast concrete manholes may be used provided they conform to Section 13.09 of these specifications.

Manhole bottoms shall be constructed of 3000 PSI Class "A" concrete and shall be a minimum of six inches (6") in thickness.

When required by the City Engineer, the foundation for the manhole bottoms shall be stabilized by placing No. 57 washed stone in the excavation.

Manhole steps shall be provided and installed in accordance with City Standard Detail 71B-2. Manhole steps shall be made with a No. 3 reinforcing rod encapsulated in a polypropylene plastic, and shall be No. PS-1 or PS-1-45, as manufactured by M.A. Industries, Inc., or approved equal.

Cast iron manhole covers and frames shall be furnished and installed in accordance with City Standard No. 71B-1. Manhole covers and frames shall be set in mortar with even bearing.

As a normal policy, all manhole rim elevations in well maintained areas such as streets, parking lots, yards, ball fields, etc., shall be set flush with the existing grade. Manhole rims set in fields, pastures, woods, etc. , shall be set 6" above the natural existing grade and backfilled flush with the rim with a maximum slope of 4:1. Manhole rims in flood plain areas, shall be set two (2) feet above the 100 year flood elevation; or a sealed manhole shall be set flush with the natural existing ground and vented according to Standard Detail 71B-4A and as shown on the project plans. The City's inspector may vary from this policy if special field conditions warrant it.

Plugs and sealed stubs shall be placed as required by the plans or as directed by the City Engineer.

The outside of the manhole shall be plastered with a 1:2 mortar mixture. Cracks between manhole blocks or brick shall be plastered thoroughly.

All iron work, in and about the manhole, shall be protected from rust.

The masonry height for adjustment of grade above the cone shall be 12 inches maximum.

Manholes shall be cleaned, and in good order, and so kept until final acceptance of the job.

Block and brick manhole specifications are included herein for use with the repair of existing structures only. All new (proposed) manholes shall be as specified in Section 13.09 herein.

13.07 Manhole Brick

All manhole brick used shall be hard rough, sound clay brick of first class quantity, especially suitable for this class of work and shall conform to ASTM Standard No. C-62 or latest subsequent revision. Over-burned brittle brick or brick from benches of kilns shall not be accepted. The brick shall be set at the time of laying, except when liable for freezing. The brick shall be laid with full shove joints, filling up the joints with mortar and the thickness of the joints on the inside of the walls must not be more than three-eighths (3/8") of an inch in width.

13.08 Manhole Block

All manhole block used in construction shall be a standard six inch (6") thick concrete manhole block and shall conform to ASTM Standard No. C-139 or latest subsequent revision and shall be those manufactured by Metromont Materials of Charlotte, North Carolina, or an approved equal. The manhole shall be constructed of two (2) types of block, the barrel block and the battered entrance block. The barrel block shall form the main body of the manhole and shall form a cylindrical section. The Standard inside diameter of the cylinder shall be four feet (4') for manholes up to fourteen feet (14') in depth and five feet (5') for manhole sections greater than fourteen feet (14') in depth. The top battered section shall form a conical section which shall have a four foot (4') diameter base and shall be constructed of four (4) courses of eight inch (8") high battered blocks. These blocks shall be designed so as to reduce the inside diameter by six inches (6") per course. The top diameter of the manhole shall be twenty-four inches (24"), and shall be the standard opening needed for the cast iron manhole ring. The blocks shall be embedded in a mortar bed to form 1/2" horizontal mortar joints and shall be laid end to end without mortar on ends. As each course is completed, the end openings shall be filled with mortar and shall be rodded thoroughly to form a watertight seal between blocks.

13.09 Precast Manholes

All precast manhole sections and components shall conform to ASTM C-478-72 or latest subsequent revision. Precast manholes shall be those as manufactured by Tindall Concrete in Spartanburg, South Carolina, Brooks/Oldcastle in Charlotte, North Carolina, Foltz Pipe Company in Winston-Salem, North Carolina, Universal

Concrete Products in Harrisburg, North Carolina, Materials Supply Co. in Charlotte(Lexington Plant), N.C., Metromont Materials, Corp., in Greenville, S.C., and Tru-Contour in Harrisburg, N.C.; but in all cases shall meet all provisions contained herein..

Precast manhole sections shall consist of circular sections with nominal inside diameters of 48" and 60". Heights of the sections may be in multiples of 12" at the option of the Contractor. The nominal wall thickness for 48" and 60" diameter sections shall be minimum of 5", and shall be designed to support all dead load and HS-20 traffic loads.

Reinforcement for precast manhole sections shall consist of a single cage of steel, placed at the approximate center of the wall section. The 48" diameter sections shall have not less than 0.12 square inches of circumferential steel per linear foot of barrel and the 60" diameter section shall have not less than 0.17 square inches of circumferential steel per linear foot of barrel. The cage steel shall be welded at every circumferential wire, or lapped 40 wire diameters and tied. The welded splice shall develop a tensile strength of 50,000 PSI of the wire diameter.

Joints between sections shall be tongue and groove, and shall provide 0.10' nominal annular space, height shall be 4". Joint surfaces and tolerances shall be as per ASTM C-361. All joints shall be sealed with either an "O" ring seal conforming to ASTM C 443, or with an approved Butyl Rubber Sealant conforming to Federal Specification SS-S-210A, AASHTO M-198, for Type B-Butyl Rubber. Approved sealants are "Kent Seal No. 2, "Conseal CS-102 or CS-202", RuVan RV30, Press-Seal "Pro-Stik", **"Bidco" Sealants, "Butyl-Nek", and "E-Z Stik"**, or approved equal. Care is to be taken with the Butyl Rubber Sealant to make sure manufacturer's recommendations and overlaps are properly followed. Butyl Rubber Sealant shall be kept in original containers, stored in a cool area and kept free from foreign materials.

Manhole steps shall be cast, drilled, or firmly grouted in place so as to ensure completely watertightness, any step holes shall not extend through the manhole wall. Steps shall be spaced at 16" centers and installed so as not to interfere with the reinforcing steel. Steps shall be No. 3 reinforcing rod encapsulated in a polypropylene plastic, No. PS-1 with a depth ring, as manufactured by M.A. Industries or approved equal.

No more than two lift holes shall be cast into each section. Holes shall be located so as not to damage reinforcing steel or expose it to corrosion. Steel loops may be provided for handling, in lieu of lift holes.

Precast conical eccentric transition sections shall be provided for reductions in diameters. The transition manhole sections shall conform to the cross-section as shown on City Standard No. 71B-4. The height of the transition section

shall not be less than 24". Transition and barrel sections shall be free from fractures, cracks and surface roughness. All manhole components shall be capable of producing a watertight structure. Special Engineer's approval is required to use flat transition slabs or flat tops.

Manholes shall have precast concrete bottoms with integral walls extending to a minimum of six inches (6") above the top of the highest pipe line, except as shown on the plans. Precast manhole sections shall be affixed to a monolithic poured bottom to provide a watertight seal, and constructed in accordance with City Standard Drawing No. 71B-4. Pipe openings shall have a cast-in-place rubber sleeve or rubber boot complying with ASTM C 923 designed to provide a flexible watertight seal around the pipe and between the sleeve/rubber boot and the manhole. Approved boots are "PSX", "Kor-N-Seal", and "EPCO". The cone section shall be the eccentric type, unless approved otherwise for a specific location for each use.

Inverts of the manhole shall be constructed as specified in Section 13.06 of these specifications. Inverts shall be poured-in-place, using the base section as form, and shaped as required for the proper flow. Separate pour pre-cast inverts may be used, approval required.

Holes or openings left in barrel sections for pipe connections shall be constructed so as to provide a minimum clearance between pipe and edge of opening as recommended by the manufacturer of the boot to be installed. This space may need to be mortared to produce a watertight seal and support the pipe, see the manufacturer's recommendations.

Alkalinity of the concrete used for the manholes shall be adequate to provide a Life Factor, AZ equal to the calcium carbonate equivalent times the cover over the reinforcement of no less than 0.35, for bases, risers, cones, transition and adjustment pieces.

Chemical Admixtures shall be as per ASTM C 494. Calcium chloride or admixtures containing calcium chloride shall not be used.

Any interior patching of wall penetrations shall be by using a two-component epoxy gel, solvent free, moisture insensitive, high modulus, high-strength, structural epoxy paste adhesive meeting ASTM C-881, Type I and II, Grade 3, Class B and C, Epoxy Resin Adhesive.

The masonry height for adjustment of grade above the cone shall be 12 inches maximum. **Butyl rubber sealant shall be provided between the frame, grade rings, and all manhole sections.**

Corrosion Protection for Manholes

1. Where corrosive conditions due to septicity or other causes are anticipated, consideration shall be given to providing corrosion protection on the interior of the manholes.
2. Where high flow velocities are anticipated, the manholes shall be protected against displacement by erosion and impact.

Tie-ins at existing manholes shall be constructed to the same standards as specified for new manholes herein. Any exceptions shall be as approved by the Engineer. Payment for all "Tie-in at Existing Manholes" shall include all labor, equipment, and materials necessary to tie the sewer line into the existing manhole.

(G) Payment for manholes shall include all material, labor, and equipment necessary to install the manholes to comply with the Project Plans and bid documents. Payment for this item shall be based on the actual number of manholes complete in place, for depth installed as determined by the City Engineer.

13.10 Cement

Cement used shall be of a high grade Portland Cement of a brand approved by the City Engineer. It shall meet AASHTO M-85-49 or latest subsequent revision. Cement shall be newly manufactured, well housed and preserved dry for use. No cement which has been injured by age or exposure shall be used.

13.11 Sand (Fine Aggregate)

All sand used shall be clean, sharp coarse grain sand and shall be free from clay, loam or organic matter and shall be subject to the approval of the City Engineer.

13.12 Water

Water used in Portland Cement mortar or concrete shall be free from oil, alkali, or other organic substances. No free use of City water will be permitted. If water is used from City's supply, the Contractor shall make arrangements with the City Utilities Department, and shall be required to pay for such water used.

(G) On City let projects, the city will allow the use of City water for construction without any additional charge. This will be subject to availability and to all City Departmental Policies, **Backflow prevention and metered use will be required, the contractor shall supply all necessary equipment, materials, and labor. See section 2.03.**

13.13 Mortar

Mortar for brick work shall be composed of one (1) part Portland Cement to three (3) parts fine aggregate. Mortar for plastering shall be composed of one (1) part cement to two (2) parts fine aggregate.

During cold weather, mortar and brick work may be placed when the air temperature in the shade is 40⁰ Fahrenheit or above and rising. It may not be placed when the air temperature in the shade is 42⁰ Fahrenheit and falling.

13.14 Concrete

Concrete used shall consist of Portland Cement, fine aggregate, coarse aggregate, water and admixtures to a design mix approved by the City Engineer. It shall have a twenty-eight (28) day compressive strength of 3000 PSI.

No water shall be added to the mix, except that called for in the mix design. Water added to the concrete enroute to the job site or on the job site shall be reason enough to reject the batch and have it removed from the job.

13.15 Manhole Frames and Covers

All castings shall be of good quality cast iron manufactured on Number One grade scrap or equivalent. No other casting shall be considered. Castings must be free from blow holes, sand holes and any other defect, and shall conform strictly to the dimensions shown on the City's Standard Drawing No. 71B-1. Gray Iron castings may be supplied with "no paint". Weight of the manhole ring and cover shall be approximately 310 Pounds.

Machining on certain parts of the manhole ring and cover shall be required. That portion of the manhole cover which is to be machined shall be the horizontal surface on the underside which comes in contact with the ring. This

machined surface shall be 1-3/8" in width along the full circumference of the cover. That portion of the manhole ring or frame which is to be machined shall be the inside horizontal surface upon which the cover sits. This machined surface shall be one inch (1") in width, along the full circumference of the ring.

The machining described above shall be so accomplished so as to leave the machined surfaces in a true even plane, so that when the cover is placed on the ring in any position, the machined surfaces will be in full contact and even bearing, with no tilting or rocking motion. The machining to be done is in no way intended to decrease the thickness of the parts machined, but will have the dimensions shown on the City's standard drawing.

Locking Watertight Covers for Outfall Construction

Locking watertight frames and covers shall be used on outfall construction. Frames and covers shall be produced from ASTM A 48-74, class 30 iron. The minimum weight of the frame and cover shall be 310 pounds, as per Detail 71B-1.

The frame flange shall have four one-inch holes at 90 degrees for anchoring the flange to the concrete manhole with 4 each - 5/8" dia. bolts. The Contractor shall coordinate the bolt circle diameter with the manhole and frame suppliers. The cover shall have four holes for bolts at 90 degrees for locking the cover to the frame. The frame shall be tapped and the cover attached using four hexhead 1/2" X 1-3/4" brass or stainless steel bolts. A neoprene gasket shall be provided between the cover and the frame seat. Butyl rubber sealant shall be provided between the frame, grade rings, and all manhole sections. Vulcan's (E.J.I.W.) watertight cover V-2384 and U. S. Foundary's USF 669 & KL with BWT cover meets these requirements. Only frames and covers manufactured and tested in the U.S.A. will be allowed.

Manhole covers are to be provided with two one-inch diameter holes for ventilation, unless the Project Plans indicate that the manhole is to be vented to a specified elevation or a sealed manhole indicated. Vented manholes shall be as indicated on the project details and Std. Detail 71B-4a as revised 1/05/95 or later revision.

(G) Payment for all manholes shall include all material, labor, and equipment necessary to install the manholes to comply with the Project Plans and bid documents. Payment for this item shall be based on the actual number of manholes complete in place, for depth installed as determined by the City Engineer.

13.16 Concrete Encasing for Pipe

Encasing for pipes shall consist of plain 3000 PSI Class "A" concrete as a protective cover and reinforcement poured and formed to the cross-section as shown in City Standard Detail 71B-15.

This protective cover shall be required when shown or indicated on the plans, or when directed by the City Engineer.

13.17 Laying Pipe and Making Joints

The pipe shall be laid beginning at the lower or down-stream end of the line and shall progress continuously upstream. Under no circumstances shall the Contractor leave out any section of the line to work on another portion further upgrade, without first securing written approval from the Engineer.

Each joint of pipe shall be laid according to manufactures recommendations and, in accordance with latest revision of ASTM Standard No. C-12 for Clay Pipe, and according to AWWA HI-67, AWWA C-150, AWWA C-600 and ASTM A-746 for Cast and Ductile Iron Pipe. Care shall be taken in placing pipe so that prior made joints are not disturbed. Competent pipe layers shall be required for pipe installation. Lines that do not exhibit true line and grade or have structural defects shall be corrected at the Contractor's total expense. Refer to Section 15.00 also.

At the end of each days work, the Contractor shall plug all pipe ends.

Trench Preparation

The Contractor shall prepare the pipe trench according to the "Project Details, and to the Standard Specifications" including but not limited to Sections 10.03, 10.04, 13.0, 14.0, and 15.0 thereof and pipe manufacturer's recommendations.

Class B Bedding

Class B bedding shall consist of bedding the pipe in compacted granular material placed on a flat trench bottom, after jointing of the pipe, extending the compacted granular material along the sides of the pipe to the level 1/2 the diameter of the pipe, and the placement of compacted select backfill material to a depth of 6" above the top of the pipe, all as specified herein and detailed on the Drawings.

Depth of compacted granular material under the pipe shall be not less than 4".

The granular material shall have a width equal to the width of the pipe trench and the length as indicated on the Drawings or as directed by the Engineer. Granular material used for Class B bedding shall be washed stone conforming to the gradation requirements of the N.C. Department of Transportation standard specifications for No. 57 standard size aggregate. Granular material shall be placed in layers not more than 6" in thickness and each layer thoroughly tamped with approved mechanical tampers being extremely careful to completely fill all spaces under and adjacent to the pipe. The granular material shall be placed under and adjacent to the pipe by hand if necessary to completely fill all spaces under and adjacent to the pipe. (G) All costs for providing Class B bedding as specified above shall be included in the unit price for pipeline installation.

Class C Bedding

Class C bedding shall consist of granular material complying with the requirements specified for Class B bedding, except that granular material shall extend up the pipe barrel at least 1/6 the outside diameter of the pipe. All other aspects of granular material gradation, backfilling, compaction, etc., shall be as specified for Class B bedding. (G) All costs for providing Class C bedding as specified above shall be included in the unit price for pipeline installation.

Class D Bedding

Class D bedding shall consist of square cut trench bottom with bell holes. Wherever rock is encountered for Class D bedding conditions the rock shall be removed for at least 6" below pipe and replaced with compacted backfill to the required pipe bedding grade. (G) All cost for providing Class D bedding as specified on the Project Details shall be included in the bid unit price for pipeline installation.

Concrete Encasement

Concrete encasement shall be made of **3000** psi class concrete and shall be constructed in accordance with details shown on the Drawings. The Contractor shall submit for approval of the Engineer his proposed method of supporting the sewer to maintain line and grade while the concrete encasement is being constructed. All concrete encasement shown on the Drawings shall be included in the base bid and any additions to or deductions from this amount ordered

by the Engineer shall be adjusted on the basis of the unit price stated in the Contractor's bid for non-reinforced concrete encasement, per cubic yard, complete in place. All concrete encasement placed without the prior order of the Engineer shall be at the Contractor's expense. **Also, see section 13.16.**

Trench Stabilization (#57 washed stone) will be required when a wet or poor subgrade condition is encountered by the Contractor and when in the City Engineer's opinion other proper foundations cannot be provided. Refer to Standard Specifications Section 15.04 for additional requirements.

(G) All cost for trenching, backfilling, backfill material, trench stabilization (#57 washed stone), etc. shall be included in the Contractor's bid unit price for pipe complete in place.

Rock Excavation

Excavation of hard rock, ledge rock, or boulders larger than two cubic yards which can not be ripped, clawed, etc., and or removed by conventional construction methods will be considered as Rock Excavation.

All blasting operations (use of explosives) shall be conducted in strict accordance with existing laws, rules, and regulations relative to the storage and use of explosives. Blasting shall be performed only by experienced personnel working according to accepted practice. The Contractor shall be responsible for securing all necessary permits including, but not limited to the City Fire Department. The Contractor shall comply with the City's Standard Specifications including, but not limited to Section 2.08. Extreme care shall be exercised by the Contractor to prevent injury to any existing pipes, water, sewer, gas, poles, wires, cables, drains, buildings or other structures or utilities either below or above the surface of the ground. The Contractor shall be solely responsible for any and all damage resulting from the use of explosives. Where there is any possibility of damage being caused by blasting it may be necessary to resort to drilling, wedging, and splitting to remove the rock.

Any rock encountered shall be excavated six inches (6") below the subgrade of the pipe bed. See Pipe Material for payment of unsuitable material and/or backfill material. (G) Payment for rock excavation shall include all labor, materials, and equipment necessary to remove the previously described rock and deposit it off site in a Contractor supplied spoils area or, if an area is approved by the Engineer, with the Project Limits.

(G) Payment for rock excavation shall be as per the Contract unit price as established in the Proposal. The quantity shown is estimated and is approximate. Payment shall be based on the actual quantity approved as Rock Excavation.

13.18 Testing

The Contractor shall make the construction site and pipe installation available to the City Engineer or his representative at all times for performing tests on the materials and construction. These tests shall include, but not be limited to, the following:

(a) Compaction of Ditch

Backfill material shall be thoroughly tamped as specified in Section 6.06 of these specifications and shall be tested in accordance with AASHTO T99-57 test procedures for field density.

(b) Alignment and Grade

The alignment and grade of the line shall be checked during installation by the use of blue top grade stakes. The lines shall be laid straight, within one fourth (1/4") inch variation per joint, but in all cases so that a full moon is visible from manhole to manhole. Lines which do not exhibit a true line and grade or have structural defects shall be corrected to meet these specifications.

(c) Infiltration/Exfiltration

(1) The Contractor shall provide the equipment, materials and labor necessary to check the lines for infiltration or exfiltration before they are put in service. Infiltration or exfiltration in excess of one hundred (100) gallons per day per inch-mile of sewer will result in having the Contractor go over the lines, ascertain where the leakage exists, and repair the lines to the extent necessary to bring the infiltration or exfiltration down within acceptable limits. The Contractor shall test only pipe of the same diameter and for such lengths as approved by the Engineer.

(2) Exfiltration tests shall be conducted on all gravity sewer lines, unless authorized otherwise by the City Engineer. The line under test shall be plugged and filled with water in such a manner that

the maximum hydrostatic head at any point in the line would not exceed ten feet of water. All manholes shall be tested. The exfiltration from the line under test shall not exceed 100 gallons per inch of nominal pipe diameter per mile of pipe per twenty-four hours. The amount of exfiltration shall be measured by the inspector using methods specified by the City Engineer for the particular situation.

- (3) Where ground water is encountered during construction, the Contractor shall furnish labor, equipment, and materials including pumps, and shall assist the Engineer in making infiltration tests of the completed sewer section before it can be placed in service or connected to any other lines. The Contractor will furnish and install the measuring weirs or other measuring devices. The length of line to be tested at any time shall be subject to the approval of the Engineer. The total infiltration shall in no case exceed 100 gallons per inch of diameter, per mile of pipe per day. The test period shall be twenty-four hours, and if the quantity of infiltration is in excess of the maximum allowable, the leaking joints shall be relaid if necessary or other remedial construction shall be performed by and at the expense of the contractor. The section of sewer shall then be retested after repairs are completed to determine compliance with the specifications.
- (4) The infiltration in the line shall be checked thru a low pressure exfiltration air test. The sanitary sewer pipe and lines shall be capable of reaching a constant pressure of 4 psig within the time specified in Table 1 and shall be capable of maintaining the pressure for the time limit specified in Table 2. The City may at its option perform a visual inspection of the pipe complete in place by passing a video recording camera thru the pipe. Any visible defects, as specified in ASTM C-700-78a or latest addendum, will be justification for rejection and the contractor shall repair the rejected section of pipe at his own expense. The City will supply the equipment necessary for making the air pressure test and the video recording of the sewer line. The Contractor may be required to supply one laborer to assist the engineer. (CITY OPTION) The City may, upon notification, require that the contractor perform the subject video testing under the scrutiny of the inspector, tapes shall be supplied to the Engineering Division along with any required comment sheets.
- (5) All tests shall be made in the presence of the contractor or his representative and the Engineer. The costs for these tests shall be included in the unit price bid for installing the pipe.

- (6) Any and all work necessary to bring the line into conformance with the infiltration/exfiltration specifications shall be performed by the contractor at no extra cost to the City. All apparent sources of infiltration shall be repaired. The City reserves the right to require that the lines be tested in sections such that the maximum allowable static head is imposed on as much of the line as is practicable.
- (7) Where a stream is not readily available as a source of water to use for testing, water from the City system may be used, providing proper notification procedures for operating valve hydrants will be required.
- (8) Materials and construction methods called for in these specifications are of such nature as to insure maximum protection for the sewer from infiltration. The contractor shall be responsible for the sewer conforming to the above limits for a period of one year from date of final acceptance.

TABLE 1

TIME REQUIRED TO PRESSURIZE To 4 PSIG*

TIME (IN MINUTES)

PIPE SIZE	<u>REACH OF LINE TESTED</u>						
	20'	100'	200'	300'	400'	500'	600'
4"	6 sec.	0.5	1.0	1.5	1.9	2.4	3.0
6"	12 sec.	1.0	2.2	3.2	4.4	5.8	6.4
8"	23 sec.	1.9	3.8	6.0	7.6	9.6	11.6
10"	35 sec.	2.9	5.8	8.8	11.6	14.6	17.6
12"	50 sec.	4.2	8.4	12.6	16.8	21.2	25.6
15"	1.3 min.	6.6	13.2	19.8	26.4	35.0	39.6
18"	1.9	9.4	18.8	28.2	37.6	47.0	56.4
21"	2.5	12.6	25.2	37.8	50.4	63.0	75.6
24"	3.4	17.0	34.0	51.0	68.0	102.0	136.0

* This table is based on the compressor unit mounted on a Cherne Air-Loc Testing unit assuming 5 cfm capacity.

TABLE 2

MINIMUM TEST TIME FOR VARIOUS PIPE SIZES

NOMINAL PIPE SIZE IN.MIN/100 FT.	T (TIME)	NOMINAL PIPE SIZE IN.MIN/100 FT.	T (TIME)
3	0.2	21	3.0
4	0.3	24	3.6
6	0.7	27	4.2
8	1.2	30	4.8
10	1.5	33	5.4
12	1.8	36	6.0
15	2.1	39	6.6
18	2.4	42	7.3

The low pressure air test shall be performed as specified in latest revision of ASTM C 828 for VCP and ASTM C924 for RCP. If the line pressure drops more than 1 PSI during the required test time, then the section of pipe has failed the test.

Furthermore, in testing any sanitary sewer line, the infiltration/exfiltration rate shall be less than 100 gallons per inch diameter of pipe per day per mile of sanitary sewer. See Section 13.18(c) (1), (2), and (3).

13.19 Taps/Service Connections (Sewer)

Only authorized personnel of the City of Gastonia Utilities Department shall be permitted to make sanitary sewer taps unless the developer has received permission, in writing, from the City's Public Works and Public Utilities Director or designated representative, for an approved Utilities Contractor to make these taps.

All taps shall be made in strict conformance to City requirements. No tap shall be made before the tests are complete and approved.

Sanitary sewer service connections may be installed by the developer of property upon request. The Application (form supplied by the City) should be completed and sent to the Public Works and Public Utilities Director. Material for these services will be obtained by the contractor.

Materials used in making the sanitary sewer service connection shall be as follows:

- 4" Pipe - CI soil pipe or PVC-DWV Sch 40 (Type 1 Grade 1) ASTM D-2665-68 (Solvent Cemented Joints) PVC sewer service pipe shall be NSF approved, and shall be made of PVC plastic having a cell classification of 12454-B as per ASTM D-1784 (12454-B is old type 1 grade 1)
- 8" x 4" Saddle - ROMAC STYLE "CB" - O.D. Range (6.275 - 25.80) (Tie ins at manholes, and tees are to be used where at all possible, Wyes maybe used with an additional 1/8 horizontal bend to keep the tap perpendicular to the street)
- 4" Plug - 4" PVC Cap Plug (remove when tap attached from building)
- 4" Combination long turn Wye and 1/8 bend (for clean out)
- 4" PVC Plug (recessed cap)
- 4" 1/8 Bend
- 18" x 18" x 5-3/4" Concrete collar with 6x6 welded wire reinforcing and a 6" diameter hole for the clean-out, or 4" sewer clean out pad with #3 reinforcing bar as manufactured by Masonry Supply, Inc. in Selma, N.C.

Fernco Donut required when tying into tees. (See Section 13.20 for adapters and further requirements for taps into PVC Sewer Pipe.)

All material will be inspected for compliance by Water and Sewer Division inspector prior to installation. All services will be inspected prior to backfill operation for compliance. The backfill and compaction operation shall be according to standard procedure, and the Standard Specifications including Section No. 6.06.

All taps shall be made in a method approved by the Director of Public Works and Public Utilities, and according to Standard Details including 71B-19. All taps installed by cutting into the sewer main shall be made with the use of a tapping/coring machine if saddles are used. (The use of a hammer and chisel or other manual impact methods will not be allowed.)

Any customer service connection required to be installed into any outfall sanitary sewer line will be tied into either a proposed manhole shown on the Project Plans or into an added manhole as required and approved by the City Engineer.

See section 13.25 for smoke testing requirement on existing taps to be reconnected.

Pavement cuts across public streets for services shall be avoided. The contractor shall install these lines using an air pressure driven, pneumatic "mole" or an auger type machine. If an open cut is unavoidable, the contractor shall secure approval from the City Engineer prior to making any street cut for a service line.

No sanitary sewer tap shall be permitted until the curb and gutter has been installed. All tap locations shall be shown on the "as-built" plans and shall be marked on the top of the curb with "arrow" indicating the water and "X" indicating the sewer .

See Section 2.63 for additional as-built requirements.

13.20 PVC Sanitary Sewer Pipe and Fittings

PVC sewer pipe may be permitted only in areas that generate domestic sewage, are zoned for residential use, and where all up stream drainage areas have residential zoning designations and uses. PVC sewer pipe may be installed in some commercial development; however, each project must be evaluated and approved by the City Engineer on a "case by case" basis.

When **8" thru. 15"** diameter polyvinyl chloride (PVC) pipe is specified on the approved project plans, unless otherwise specified, the PVC pipe shall be as specified in ASTM D-3034 with a Standard Dimension Ratio (SDR) of 35, or **PVC composite pipe (Truss) conforming to ASTM D-2680, latest addendum as used with solid PVC tees for taps.** PVC sewer pipe shall be furnished with an integral bell and elastomeric gasketed joint permanently installed at the factory in accordance with ASTM D-3212 and ASTM F-477. The pipe shall be furnished in nominal lengths of 13 feet or as approved 20 feet, shall be green in color, and shall be manufactured and tested in the U.S.A. 12" and 15" may also include pipe conforming to ASTM F-949 having exterior corrugated ribs.

Sewer and Water crossings shall be as specified in Section 2.12 of the City of Gastonia Standard Specifications. Couplings for jointing PVC to ductile iron pipe (DIP) sewer pipe shall be accomplished by using the appropriate Fernco "Donut", or approved equal. Flexible repair couplings will not be allowed.

All fittings used on PVC sewer mains including tees for taps, shall meet the same specifications as those of the PVC sewer main. To couple the tapping tees to the sewer lateral bend, it will be necessary to use an SDR 35 to Schedule 40 PVC slip-by-hub adapter. See Section 13.19 of the City of Gastonia Standard Specifications for tap requirements.

The Contractor shall provide adapters, seals, and transitional pieces as required for connecting to other pipe or structures shown on the Drawings or indicated in the bid documents. Flexible repair couplings will not be allowed. Any field cut ends shall be as per the pipe manufacturer's and AWWA's recommendations.

In all instances PVC pipe shall be installed in an acceptable manner, true to line and grade, with the bell ends facing up-grade. The various pipes, referred to herein, shall be handled, belled up and installed in accordance with the manufacturer's recommendations and established engineering practices as described in the various publications referenced in this document. See section 13.17 also.

All PVC pipe shall be shipped, stored, and placed at the project site in a manner so as to be protected from total accumulated exposure to sunlight and ultra violet radiation of no more than six (6) months, no defects shall be visible. Any visible defects including but not limited to chalking, discoloration, blisters, or loss of sheen shall be cause for the pipe to be rejected and replaced. Any testing suggested in lieu of the above shall be at the manufacturer's expense, all such test shall be performed by an independent laboratory.

Class B bedding as described on Standard Detail 71B-5A latest revision shall be used with all PVC sewer pipe. These installation requirements shall be as specified in ASTM D-2321, latest revision, Type IA Granular Embedment

(# 57 washed stone) regardless of ground water or soil conditions; the bedding shall be installed to 95% Standard Proctor. Native materials of Classes II, and III may be used above the pipe springline and shall be placed and compacted as specified in the City of Gastonia Standard Specifications. The minimum depth of cover shall be 3 feet and the maximum depth of cover shall be 30 feet.

No backfill may be placed over the PVC pipe until the City Engineer or his designated representative has visually inspected the gravel bed and PVC pipe installation. If for any reason backfill is placed prior to the inspection, the contractor will be required to remove the backfill to allow for this visual inspection. All cost for said removal and replacement of backfill, as well as any defects found, shall be at the contractor's and/or developer sole expense.

In addition to other tests, including but not limited to Section 13.18 of the City of Gastonia Standard Specifications, a deflection test will be required to be performed not less than 30 days following completion of backfill operations. The contractor shall supply all labor, equipment, and materials necessary to pull a mandrel sized for a maximum of 5% deflection of the actual pipe inside diameter, as defined in ASTM D-3034. The mandrel shall be provided by the **contractor unless the City of Gastonia decides to supply it**. The mandrel shall be pulled through each section of pipe from manhole to manhole. The mandrel must slide freely through the pipe with only a nominal hand force applied. No mechanical force shall be used in pulling the mandrel. Any pipe which refuses the mandrel shall be removed and replaced and the bedding shall be properly constructed as specified to prevent excessive deflection. Such sections shall be re-tested after completion of backfill. all cost for such testing, removal, and replacement shall be at the contractors and /or developers sole expense. If a developer desires to use PVC sewer pipe, PVC sewer pipe must be used throughout the development unless DIP is required and is shown on the plans approved the by the City Engineer. **The “Go-No-Go” mandrel test will not be required when 8” thru. 15” diameter PVC composite (Truss) pipe conforming to ASTM D-2680 is used.**

13.21 Force Mains

Pipe material for force mains shall be either Cement Lined Ductile Iron Pipe as specified in Section 14.06 herein or PVC AWWA C-900 as specified in Section 14.04 herein.

All force mains shall be tested in accordance to Section 14.15 herein with the minimum test pressure being 100 PSI.

All blocking/restraining for the fittings shall be designed to withstand the test pressure.

A properly sized and approved air release valve in a standard manhole shall be provided at all high points where a negative pressure of 10' may be produced. A weep pit of No. 57 stone shall be provided similar to Standard Detail 71B-17. Crispin valves US20B(L) and S20B(L) have been approved to the date of this printing.

13.22 Piers/Piles/Concrete Supports

This item shall include all labor, materials, and equipment necessary to construct piers according to the Standard Specifications, Standard Details, and Project Plans.

All concrete used shall be 3000 psi concrete as specified in Sections 846, 848, 1000, and 1024 of the NCDOT Standard Specifications for testing and curing requirements. All reinforcing used shall have standard deformations and a minimum yield strength of 40,000 psi. All splices shall be as required by the engineer, but in no case shall a lap splice be less than 24 bar diameters, or no less than 12 inches. Two layers of felt with Graphite Grease shall be installed between the pipe and the piers.

(G) All payment for piers complete in place, exclusive of any piles required, shall be paid at the Contractor's bid unit price per vertical foot (VF) as indicated in the Proposal.

When piles are required by the Project Plans and the Engineer, the piles shall be 8" butt diameter wood piles, treated with creosote or pentachlorophenol in mineral spirits in accordance with AWPA C-14, C-8, C-9, and C-2 as applicable. The piles shall be driven as specified in Standard Details 71B-14 and 71B-15. When the plans call for piles and rock is encountered, the Engineer may delete the requirements for piles. In deleting the pile requirement, the rock shall be undercut as directed by the Engineer to give an adequate footing.

(G) All payment for piles complete in place shall be included in the Contractor's bid unit price per vertical foot (VF) as indicated in the Proposal.

13.23 Dry Bore and Jack/Tunneling

A. Dry Bore and Jack

The Contractor shall supply all labor, material, and equipment necessary to install the sewer line without open cutting the pavement where indicated on the plans. The encasing pipe may be jacked through dry bores slightly larger than the pipe, bored progressively ahead of the leading edge of the pipe. Continuous checks shall be made as to the elevation, grade and alignment of each successive section of pipe as well as the tracks upon which the boring rig travels.

The boring operation shall be continuous to its completion.

In the event an obstruction is encountered during the boring and jacking, the auger is to be withdrawn and the excess pipe cut off, capped, and filled with 1:3 Portland Cement Grout at sufficient pressure to fill all voids. A new site will then be picked for a new bore. The Contractor shall be paid 50% of complete bore value for any bore aborted due to causes beyond the control of the Contractor. If open cut is allowed, then the aborted length shall be utilized and paid for at 100% of unit bid price for complete bores. The remaining length allowed to be installed by open cut shall be paid as per pipe installed by open cut as described in Sections including but not limited to 14.01 and Special Provisions.

The carrier pipe shall be protected so as to prevent as much foreign material from entering as is possible. This installation will have to pass the tests in the Special Provisions before it can be placed into service. See Special Provisions and Plans for controlling agent notification requirements.

The operation across the street right-of-way must conform to the requirements of the Permittee. The Contractor shall execute all necessary agreements and/or permits before entering upon or commencing any work on the street right-of-way. The Contractor shall comply also with the applicable requirements of the General Conditions and the Supplementary Conditions.

The gravity sewer line shall be Class 51 cement lined ductile iron pipe.

The minimum gauge or wall thickness shall correspond to the size of casing selected from the following chart; however, the Contractor shall be responsible for selecting the gauge consistent with his operation.

**Gauge Table for Railroad Crossings
Minimum Wall Thickness for Smooth Steel Casing Pipe for E80 Loading
(ASTM A139 Grade B; AWWA C-200)**

Nominal Diameter (inches)	When coated or cathodically protected Nominal Thickness (inches)	When not coated or cathodically protected Nominal Thickness (inches)
12 3/4 and under	0.188	0.188
14	0.188	0.250
16	0.219	0.281
18	0.250	0.312
20 and 22	0.281	0.344
24	0.312	0.375
26	0.344	0.406
28	0.375	0.438
30	0.406	0.469
32	0.438	0.500
34 and 36	0.469	0.531
38	0.500	0.562
40	0.531	0.594
42	0.562	0.625
44 and 46	0.594	0.656
48	0.625	0.688
50	0.656	0.719
52	0.688	0.750
54	0.719	0.781
56 and 58	0.750	0.812
60	0.781	0.844
62	0.812	0.875
64	0.844	0.906
66 and 68	0.875	0.938

70	0.906	0.969
72	0.938	1.000

The exterior coal-tar enamel protective coating is to be supplied in accordance with AWWA C-203, the steel casing pipe minimum thickness may be reduced by 0.063 inches, as per the table for E80.

Gauge Table for NCDOT (Street) Crossings (H-20 Loadings)

<u>Diameter Inches</u>	<u>Smooth Steel Pipe</u>	
	<u>Minimum Thickness, Inches</u>	
15-24	0.25	ASTM A139, Grade B; AWWA C-200

The Contractor shall provide a strapped timber cradle under barrel of pipe, join pipe, and slide into casing. Pipe barrels shall bear continuously on cradles.

SUPPORTS: Lumber shall be No. 2 or better Southern Yellow Pine. Lumber shall be pressure treated with creosote or pentachlorophenol in mineral spirits in accordance with AWPA C14, C8, C9, and C2 as applicable. Minimum retention shall be as designated for Contract with ground. Method of treatment in accordance with the applicable portion of the AWPA manual standards. All timbers shall be cut to size before the material is given the preservative treatment. Spiders may be approved by the Engineer.

STAINLESS STEEL BANDS: One-half inch wide by 0.020-inch thick, 304 stainless steel bands, or equal.

Prior to the start of the work, submit satisfactory evidence to the Engineer that all bond and insurance coverage requirements called for by the Permitter have been complied with. All proposed construction methods and materials for the undercrossing shall be approved by the Engineer and Permitter prior to the crossing operation, and no construction shall be started until written approval to proceed from the Permitter has been submitted to the Engineer.

PLACING SEALS AT ENDS OF CASING: After the carrier pipe has been tested and approved, place 3/16-inch black neoprene rubber seals, or 8" masonry plug, as shown on the Drawings. Encroachment approval may require weep pits, contractor shall be responsible to check with the Permit requirements and include them in his bid.

All cost for this installation (including all encasing and carrier pipes shown on the plans) shall be included in the Contractor's bid unit price per linear foot of the type of carrier pipe line installed complete in place by "dry bore and jack" method as listed on the Proposal and shown on the Project Plans, see Standard Detail 71B-25. No additional payment will be allowed for trench excavation and backfill, for furnishing and placing casing pipe, or for any other items for the crossings as shown on the Drawings. Payments to the Contractor for any services provided by the Permittee shall also be included in this item.

B. Tunneling

The tunnels on this project shall be constructed wherever required by the Department of Transportation, Railroad Company (NCDOT/R.R.) or Plans, as applicable, and where other construction methods are not feasible due to field conditions encountered, and in accordance with these and AREA or AASHTO specifications, as applicable. The liner plates to be used shall be the 4 flange type. The liner plates shall be galvanized on both sides by the hot dipped process. The minimum thickness of the plates shall be as indicated on the Drawings.

A coating of prime western spelter or equal shall be applied at the rate of two ounces per square foot, of double exposed surface. Spelter coating shall be of a first class commercial quality, free from defects, such as blisters, flux and uncoated spots.

The steel liner plates shall be given a bituminous coating meeting North Carolina Department of Transportation specifications for bituminous protected corrugated metal pipe with a minimum thickness of 0.05".

The space outside the liner plates shall be held to a minimum and grouted with a 1 to 3 portland cement grout of 50 psi through 2" openings on 4' - 6" centers provided in the top of the steel liner plates. This grouting operation shall be done with the installation of the liner plates so that at no time will the grouting operation be further than 25' from the front end or head of tunnel construction. At the end of each day's operation, the space outside the liner plates shall be grouted whether 25' or less. Grout shall be forced into each grout hole. If the grout from one hole should flow along the liner plate so as to plug the next grout hole, the plugged hole shall be opened by punching through the grout layer so that each hole may be used for grouting. The grouting operation shall be continued at each hole until all spaces outside the liner plates are filled and no grout will flow.

The tunneling operations shall proceed only a distance sufficient for placing one section of the tunnel liner, the tunnel liner placed before proceeding further, and at no time will jetting be allowed.

Blasting will not be permitted.

The Contractor and any of his subcontractors performing the work on the Railroad rights-of-way in connection with tunneling operations, shall furnish to and be approved by the Division Engineer/Manager of Insurance of the Railroad Company, a certificate of workmen's compensation and employer's liability insurance, and public liability insurance covering bodily injury: limits as established in the General Conditions, Section 43. Such insurance is to include a Contractual liability endorsement covering the obligations assumed by the Contractor in agreeing to install the pipeline. The certificate is to show that explosion, collapse and underground insurance coverage is provided. The certificate shall include a statement that the insurance is not to be changed or canceled for a period of one year after completion and acceptance of the work by the Owner and the Railroad. The certificate is to be countersigned by an authorized North Carolina resident agent with name and address of the agent denoted thereon. The certificate is to make reference to the project and county.

The Contractor shall furnish to and be approved by the Railroad Division Engineer/Manager of Insurance, an original policy of Railroad Protective Liability Insurance (RPLI) in the name of the Railroad Co. (Company). Said Policy shall have a combined single limit of \$2,000,000.00 each occurrence and \$6,000,000.00 aggregate. The insurance shall be written on ISO/RIMA Form No. CG 00 35 11 85 and include endorsement form No. CG 28 31 11 85. The original Railroad Protective Policy shall be submitted to and approved by Company prior to commencement of construction, maintenance of said Facility or entry on Company's property. Said RPLI coverage is available through the Railroad Company's Blanket Policy.

After approval of insurance certificate, the Contractor shall notify NCDOT/R.R., and City 72 hours in advance of the start of the tunnel operation.

The entire operation shall be subject to inspection by the NCDOT/RR and the Engineer or Inspector on the project shall have full authority to stop work if, in his opinion, it shall cause any damage to the roadway section or endanger traffic.

The Contractor shall reimburse the NCDOT/RR for repair costs, should any settlement or damage appear to the roadway within a period of one year after completion of the tunneling operations.

After the tunneling operations have been completed, the vertical shoring for pits, surplus fill and material shall be removed from the site. The site shall be returned to its original condition, seeded and mulched where required, and the area shall be left in a neat and satisfactory condition.

COSTS

(G) Costs of all materials and construction methods, such as barricades, pipe casing, concrete casing, stone stabilizer, tunneling, tunnel liner, watchmen, or any other costs which are incurred as a result of the requirements herein or by the NCDOT/RR shall be included in the unit price per linear foot of tunnel liner installed as indicated on the Project Plans and the Proposal. No adjustments will be made to the unit price for the Highway and/or Railroad crossing as the result of the construction methods utilized.

(G) Skewed, unbalanced, or unreasonable unit bids will be considered grounds for rejecting the bid in whole or in part as determined by the City.

13.24 Rip Rap

Rip rap shall be Class 1 rip rap as specified by the NCDOT Standard Specifications for Roads and Structures.

Place rip rap carefully to avoid disturbing the filter fabric. Average depth of rip rap shall be as shown on the Drawings with a plus or minus tolerance of not more than 2". Intermix the sizes of rip rap material to provide uniform gradation between small and large material. Prevent damage to pipe or other facilities.

Filter fabric shall be nonwoven polypropylene, polyethylene, polyester, and/or nylon continuous filament fabric with an equivalent opening size of 80-100 openings per inch. Dry grab strength (ASTM D 1682) shall be at least 100 pounds and dry grab elongation (ASTM D 1682) shall be no more than 35 percent. Minimum weight shall be 4 ounces per square yard.

Install filter fabric as recommended by the manufacturer and these specifications. Provide a minimum of 2 feet of overlap at joints. Loosely secure fabric in rip rap area during placement.

(G) Payment for rip rap will be based on the price per ton stated in the Contractor's Proposal, and the number of tons placed within the authorized limits. This payment shall constitute full compensation for the work as specified herein including excavation to the lines and grades indicated on the Drawings, filter fabric, and placement, complete.

(G) Quantities for payment purposes shall be the actual number of tons used, based on truck measure and trip tickets signed by the Engineer. Trip tickets shall be presented to the Engineer for his signature at the time that the material is delivered.

13.25 Abandonment and Shutdown of Existing Operations of Utilities

The Contractor shall supply all necessary labor, equipment, and materials to plug and abandon in place the existing sanitary sewer outfall system as indicated on the Project Plans.

Continuous operation of the City's existing sewer system is of critical importance.

Connection to existing services or utilities, or other work that requires the temporary shutdown of any existing operations or utilities shall be planned in detail with appropriate scheduling of the work and coordinated with the Utility Customer and the Engineer. The approved schedule for shutdown or restart shall be indicated on the Contractor's Progress Schedule, and advance notice shall be given in order that the customer and the Engineer may witness the shutdown, tie-in, and start-up.

The Contractor shall be responsible for notification of each property Owner prior to disruption of service, except in the event of an emergency situation. The Contractor shall coordinate his activities with any non-City owned utility.

Only City personnel shall operate any valves and controls on the City's existing utility systems.

The testing, acceptance, tap and mainline tie-overs shall be coordinated so as to eliminate any disruptions in service. A spill, leakage, or by-pass of wastewater shall not be allowed, the Contractor and his sureties shall hold harmless and defend the City from any penalties which may result thereof.

All materials and equipment (including emergency equipment) necessary to expedite the tie-in shall be on hand prior to the shutdown of existing services or utilities.

All existing sewer taps shall be smoke tested (or other approved method) prior to reconnection, to make sure that no connection of storm water or other identified illegal inflow is present. It shall be the Contractor's responsibility to supply all labor, materials, and equipment to perform these tests and to notify the residents of such planned tests. It will be the City's responsibility to notify the Owner of any illegal inflows found, and to be sure all remedies are in place prior to allowing the Contractor to connect the tap to the new sewer line, and that the remedies are completed in a timely manner to allow the Contractor to complete his construction without any undue delay.

(G) Payment for this item, except as specified elsewhere in these Special Provisions, shall be merged in with other pay items as indicated on the Proposal, no separate pay item shall be allowed.

13.26 Demolition of Existing Manholes

Following completion of replacement of sewer lines and connection of house laterals, plug all sewer lines at each manhole on the abandoned system with non-shrink grout. Remove the abandoned manholes to depth of 4 feet below grade and fill the void with compacted sand to 18-inches below grade. Fill the remaining with top soil. Where the manhole is in a paved area the remaining shall be filled with ABC to the bottom of the utility cut patch. Restore all affected areas.

(G) Payment for demolition and filling of existing manholes shall include all material, labor, and equipment necessary and filling to demolish the manhole as called for in the Project Plans and bid documents. Payment for this item shall be based on the actual number of manholes demolished. Payment for any asphalt or concrete removal and replacement shall be as per Special Provisions.

13.27 Progress of Pipe Line Construction

The work shall proceed in a systematic manner so that a minimum of inconvenience will result to the public in the course of construction. It is, therefore, necessary to confine operations to as small a length of work area per crew as is practical. Normally, the trenching equipment shall not be farther than 200 feet ahead of each pipe laying crew or such distance as necessary to provide maximum safety. Backfill the trench so no section of properly laid pipe is left uncovered longer than is absolutely necessary. The safety conditions of open excavations shall be the Contractor's responsibility. Completely backfill and clean up after each section of pipe has been inspected and approved.

13.28 Inversion Lining

Inversion lining involves the insertion of a flexible lining material into an existing sanitary sewer pipe using an inversion process and then thermally hardening it in place.

The flexible liner will be made of polyester fibers of at least 5 denier with sufficient needling and crosslapping to yield a burst strength of 1,000 pounds per square inch in transverse directions (hoop stress), free from tears, holes, cuts, foreign materials, and other defects. Polyurethane or polyvinyl chloride shall be bonded to the inside layer of the flexible liner at 400 grams/square meter forming a nominal (0.010 inch) pin-hole-free-coating layer.

The flexible polyester fiber shall be impregnated with either polyester or epoxy, depending on application, with sufficient thixotropic properties to obtain nondraining characteristics when impregnated into the flexible polyester fiber.

A catalyst compatible with the resin and other materials shall be used in the manufacturing of the liner. The nonpromoted resin shall be catalyzed by the addition of sufficient catalyst to produce the required physical properties of the cured polyester liner.

The finished lining shall consist of an inner polyurethane or polyvinyl chloride layer and an outer polyester felt layer (or layers) impregnated with a thermosetting resin to fit tightly and neatly against the existing inside pipe wall. The liner shall be fabricated from materials which, when cured, will be chemically resistant when exposed to quantities of hydrogen sulfide, carbon monoxide, methane, petroleum hydrocarbons, moisture saturation, and dilute sulfuric acid.

The physical properties of the cured liner shall have minimum test values as follows:

Tensile Strength at Yield	Minimum 3,000 psi per ASTM D 638
Modulus of Elasticity	Minimum 300,000 psi per ASTM D 638
Flexural Strength	Minimum 6,000 psi per ASTM D 790
Flexural Modulus	250,000 psi per ASTM D 790

Impact Strength (Izod) Minimum 1.9 in. lbs. per ASTM D 256

Shear Strength Minimum 5,550 psi per ASTM D 732

Samples of material identical to the raw material to be used in the project shall be provided. In addition, specimens shall be prepared utilizing identical materials, curing, and technique which will be accepted as representative of the actual installed liner.

Unless otherwise specified, the licensed Contractor shall determine the size, length, and material composition of the liner, and warrant its suitability for the particular application and purpose specified and shown. **Design calculations, assumptions, parameters, and equations shall be based on ASTM F-1216 and D-2412 and be signed and sealed by a professional engineer licensed in N.C. The minimum extended life expectancy shall be 50 years.** The minimum thickness of the liner shall be 6.0 mm (0.235 inches).

The fiber tube shall be fabricated to a diameter that, when installed, will tightly and neatly fit the internal circumference of the conduit to be rehabilitated. Allowance for circumferential stretching during insertion shall be made. The minimum length shall be that which continuously spans the distance from the center of the inlet manhole to the center of the outlet manhole. The Contractor shall verify the lengths in the field before impregnation.

(a) Workmanship

A polyester fiber felt tube coated on one side with a flexible impermeable material and impregnated with a liquid thermosetting resin is inserted into the existing sewer line through a manhole or other access point. Water or air forces the tubing through the pipe, inverting and pressing it firmly against the existing pipe wall. The water or air is then heated to cure the resin.

After the resin is cured, service connections are remade. In pipes 8 inches diameter and larger, holes are generally cut through the lining from inside the pipe at the connection points. In 6-inch diameter pipes, the connections are generally remade in excavations in the soil above the pipe.

This Specification covers the method to insert and cure the liner using water as the medium. Prior approval of the Engineer will be required if air is proposed as the medium. The Engineer's decision to reject or allow the use of air

will be based on the Contractor's demonstration that the method is applicable and his experience in using the method is proven.

The Contractor shall submit shop Drawings in accordance with the provisions of the Instruction to Bidders. The submittals shall include details of all component materials and construction details including complete manufacturer's recommendation for storage procedures and temperatures control, handling and inserting the liner, curing details, service connection methods, and trimming and finishing. The submittals shall include insertion locations and proposed sewer flow controls.

The Contractor's operations to furnish and install the inversion lining shall be in strict conformance with the manufacturer's recommendations and shall be licensed by the manufacturer.

A representative of the manufacturer shall inspect and approve all methods employed by the Contractor. The representative shall be in attendance during the entire lining and opening of services procedure.

The Contractor shall brace or otherwise protect the manholes if necessary to withstand forces generated by equipment used while installing the liner.

The Contractor shall bypass the sewage as required to install the liner. Pumping shall be continuous and all sewage shall re-enter the sewer system.

The Contractor shall clean and television inspect each reach of sewer main to be lined. If inspection reveals an obstruction that cannot be removed by conventional sewer cleaning equipment, a point repair excavation shall be made to uncover and remove or repair the obstruction.

The location where resins and liner material will be stored shall be designated by the Contractor. The Engineer will inspect and reject any materials found defective or otherwise unsatisfactory. The "wet out" procedure shall utilize the resin and catalyst in sufficient quantities to ensure complete impregnation of the liner and provide the properties stated under physical properties above.

The Contractor shall insert the liner into the pipe in accordance with the shop Drawings. Precautions shall be taken not to damage the liner during installation.

Insertion shall be through an existing manhole or other access approved by the Engineer. Insertion shall utilize an inversion tube, or the liner itself, depending on the method selected. A static head pressure shall be applied to cause the liner to invert down the full length of the reach to be lined. The pressure shall be sufficient to overcome external pressures exerted on the liner at service connections, joints, and open sections, and to hold the tube tightly to the pipe wall, producing concave "dimples" at side connections.

After inversion is completed, the Contractor shall cure the liner using an approved heat source and water recirculation equipment. The equipment shall be capable of delivering hot water throughout the liner by means of a perforated conduit, and shall uniformly raise and hold the water temperature as required to cure the resin.

The heat source shall be fitted with suitable monitors to gauge the temperature of the incoming and outgoing water supply. Another such gauge shall be placed to monitor the temperature between the impregnated felt tube and the pipe invert at the remote manhole.

The operation of the heat exchanger and the recirculation of the heated water shall be maintained continuously throughout the cure period. Cure shall be completed when the exposed portions of the liner are hard and sound and the remote temperature sensor indicates that an exotherm has occurred. Particular care shall be exercised during the curing operation to ensure that the liner is not overstressed.

The hardened liner shall be cooled to the recommended temperature before relieving the static head pressure. Cool down may be accomplished by the introduction of cool water into the liner. Care shall be taken in the release of the static head so that surges will not develop and damage the newly installed liner.

After the liner has been cured, the existing house connection sewers shall be reconnected. It is the Contractor's responsibility to determine and assure that all live house connection sewers are reconnected.

The Contractor will notify the Engineer 4 days prior to the inversion lining of a segment of sewer. The Engineer will notify the appropriate City personnel who will notify residents served by the segment of temporary service connection interruption.

Liner shall be pressure tested for leakage. The Contractor shall submit a testing plan to the Engineer for approval.

The pipe shall be inspected by closed circuit television before and after lining and may be accomplished in conjunction with the reconnection of house connection sewers. Video tape and written log records shall be made of these inspections and two copies of each shall be given to the Engineer for review prior to acceptance of the lining work.

(b) Payment

(G) Payment for inversion lining with resin impregnated polyester felt liner will be based on the unit price listed in the Proposal. Payment shall include full compensation for all labor, material, tools, and incidentals for lining the existing sewer. The price per linear foot of resin impregnated polyester felt pipe lining shall include cleaning and television inspection of the existing sewer and reconnection of existing sewer connections complete.

13.29 Sliplining

Sliplining involves the bypass pumping, removal and replacement of asphalt and concrete surfaces, the excavating of an insertion pit, inserting a properly sized lining or carrier pipe on skids, grouting of the annular space, closure of the access pits, installation of service connections, and restoration of work site areas.

Preparation by the Contractor

Clean the existing host pipe as necessary

TV inspection of host pipe

Proof test, if necessary (pull piece of proposed liner through existing sewer)

Determine laterals to be connected or reconnected

Determine and complete any point repairs necessary

Determine insertion pits

Bypass pumping as necessary, see Section 13.25; all waste water shall re-enter the system

Installation

Contractor shall adhere to ASTM F585, PPI booklet - "renewing Sewers with Polyolefin Pipe", and the manufacturer's recommendations as are applicable. Caution is to be exercised not to stretch the liner pipe during installation.

Pipe Material

Any pipe material specified elsewhere herein as a gravity sewer carrier pipe may be used in the sliplining process. In addition, properly sized High Density Polyethylene (HDPE) pipe and fittings meeting the following minimum specifications may be used:

High density polyethylene resin compound

Type III

Class C

Category 5

Grade P34, per ASTM 1248

Meeting ASTM D3350 with cell classification PE345434C or higher

Thickness to provide SDR17 minimum, to provide a minimum life expectancy of 50 years.

The Contractor shall submit shopdrawings for all liner pipe and fittings for City approval prior to the pre-construction meeting. Any material rejected by the City shall be resubmitted with a material meeting specifications.

Joints (HDPE)

The carrier pipe may be joined with bell and spigot end construction using rubber gaskets meeting specification requirements contained elsewhere herein, or by thermal (butt) welding the pipe in accordance with the manufacturer's recommendations. All joints shall be such to provide an air tight leak proof joint.

Service Connections

Fittings shall be provided and installed to the manufacturer's recommendations to provide an airtight customer service connection, see Section 13.19 also for service connection requirements. As a normal practice the service connections should be installed prior to the grouting operation.

Testing

The entire slipline carrier pipe and connection fittings shall be tested as per Section 13.18. In addition, deflection shall be tested in accordance with Section 13.20. Care shall be exercised in determining and use of the mandrel in the proximity of the HDPE "butt" welded joints. The air test shall be performed after any go-no go device test where such "butt" welded joints are utilized. Other testing such as "full moon" visual and for sections failing that test flooding the pipe and TV final inspection may be required to guarantee that the grouting operation did not float the carrier/slipline out of position.

Grouting

The entire annular space between the host/casing pipe and the slipline/carrier pipe shall be filled under pressure. The Contractor and field Engineer shall calculate the volume of this space and keep records of the grout quantity used to certify to the completeness of the grouting process. Additional access holes may be necessary to achieve the complete grouting of the annular space, service connection access points may be used for the grouting purpose also. The maximum grouting pressure shall be 20 psi and shall be as recommended by the manufacturer of the slipline pipe material. Optional, a PVC header pipe with tees, or grout wand may be attached to the top of the slipline by the skid bands to aid in the grouting process. The Engineer may waive this grouting requirement when in his opinion the difference in the ID of the host pipe and the OD of the liner pipe is less than (1") one inch.

In the event that the sliplining/grouting process requires that the inverts be raised, the Contractor shall include in his bid unit price for sanitary sewer pipe renewal, the cost for construction of new invert troughs and benches in all manholes, see payment. The Contractor shall cut in access points into the slipliner pipe at each manhole.

Skids

Wood skids or supports shall be as specified in Section 13.23 and similar to the Standard Detail 71B-25. Approved equal spider support devices may be used as recommended by the pipe manufacturer, but in no event spaced further apart than 7.5 ft. centers for PVC or PE pipe, or one support at each joint for DIP. No creosote treated wood nor petroleum products (e.g., oil or grease) shall be used. Flax soap or drilling mud may be used as a lubricant for the skids to casing installation.

End Seals

End seals at each manhole shall be constructed with any City Standard mixture of concrete, brick and mortar or grout as specified elsewhere in these provisions.

Restoration

The insertion pit areas and other areas of construction shall be restored as per Section 4.01.

Payment

(G) All cost for the renewal of an existing pipe line as indicated on the Project Plans by insertion of a slipline shall be included in the Contractor's bid unit price per linear foot for sanitary sewer pipe renewal. The casing and carrier pipes shall be as specified in these Special Provisions, on the Project Plans, and/or the Proposal. No other payment shall be made except as specified elsewhere in these Special Provisions and when bid unit prices are requested on the Proposal, any and all other cost shall be merged into the bid unit prices as requested on the Proposal. All pavement cuts and repairs (asphalt and concrete) necessary for the sliplining, tap tie-in, and grouting process shall be included in the Contractor's bid unit price per linear foot for sanitary sewer pipe renewal, even when there are proposals and specifications for asphalt and concrete removal and replacement for the remaining conventional pipe installation on this project elsewhere in these Provisions.

13.30 Protection of Existing Structures

Existing structures adjacent to the project are susceptible to vibration and settlement damage. The Contractor is advised that he must take extreme care and in some cases must implement special construction procedures when proceeding with his work to assure that these structures are not damaged.

Prior to beginning work the Contractor shall photograph all structures located within 30 feet of the centerline of the new pipe. A minimum of 20 photographs shall be taken of each structure. The photographs shall be camera dated and two prints of each photograph shall be turned over to the City of Gastonia. After the completion of the pipe installation, backfill, and all site restoration, a minimum of 20 photographs each, shall be taken at the same structures as at the beginning of the project. Two prints of these dated photographs shall be provided to the City of Gastonia. The photographs taken at the completion of the project shall show the same general part of the buildings as the photographs taken at the beginning of the project. The photographs shall be taken of the side of the structures adjacent to the work and particular emphasis shall be on foundations, doors and windows, and corners.

The following restrictions will be implemented by the Contractor when proceeding with this work.

- a) Construction equipment cannot be used within 10 feet of any existing structure.
- b) Hand excavation, power spades, and small hand tampers will be required to accomplish the pipe and manhole installation when standard motorized equipment cannot be used. The type, size, and general use of this equipment will be approved by the City of Gastonia representative prior to the work preceding.
- c) OSHA and North Carolina trench supports and shoring standards shall be adhered to. Additional trench supports and shoring will be required whenever work is close to an existing structure.

The Contractor shall exercise extreme care and take all precautions during excavation and construction operations to prevent damage to any existing structure. Any damage caused by the Contractor shall be reported immediately to the City of Gastonia and such work shall be repaired and/or replaced by the Contractor in a manner approved by the City of Gastonia. All costs to repair and/or replace any damage to existing structures shall be the sole responsibility of the Contractor and such repair or replacement shall be performed expeditiously without cost to the City of Gastonia.

(G) All cost for this item shall be merged into other pay items.

13.31 FIBERGLASS METERING MANHOLE

GENERAL

Under this section of the specification the contractor shall furnish and install at the location(s) shown on the drawing(s), totally integrated fiberglass Packaged Metering Manhole(s) as manufactured by Plasti-Fab, Inc. P. O. Box 100, Tualatin, Oregon or approved equal. The same manufacturer shall fabricate the barrel, flume, ladder and accessories as well as fully assemble the unit. This is to assure quality control and single source accountability. Manufacturers other than the above named company wishing to quote on equipment in this section shall submit detailed drawings of their proposed equipment, a list of at least five similar installations (with contact names) which have been installed for over two years, and test reports showing full compliance with ASTM D 3753-81 for Fiber-Reinforced Polyester (FRP) Manholes to the engineer and obtain his written approval to quote at least 10 days prior to bid opening.

Each Packaged Metering Manhole shall be a completely integral unit consisting of: a corrosion resistant fiberglass reinforced plastic (FRP) manhole with sealed fiberglass bottom, (22 1/2 inch diameter concentric manway opening/48 inch diameter hinged fiberglass cover with locking hasp), fiberglass access ladder, metering flume and accessories as required. Two neoprene boots with stainless steel clamps sized to connect inlet and outlet pipe stubs shall be supplied by the manhole manufacturer and the manhole will be equipped with hold down brackets for anchoring the unit to a concrete slab. A 1/2 inch thick expanded polystyrene bead board will be supplied for placement on the concrete slab under the manhole.

COVER/HATCH

(For above grade hinged cover) The Packaged Metering Manhole will be furnished with a fiberglass cover equipped with heavy duty stainless steel hinges having 1/2" diameter hinge pins and stainless steel hasp for locking.

The cover shall be sufficient strength to withstand 1000 lbs. top load. The cover shall overlap the manhole and seat on a neoprene seal to prevent dirt, rain and debris from getting into the manhole.

COVERS for STREET R/W INSTALLATIONS

(For all H-20 Highway loadings and in-street covers) The Packaged Metering Manhole concentric manway opening shall be designed to withstand a 16,000 lb. vertical dynamic wheel load(H-20), plus lateral forces from earth loading, ground water and frozen soil. The manhole opening shall be a 22 1/2 inch manway for use with a cast iron cover, suitable for H-20 highway loading.

Height Requirements:

The fiberglass manhole will be of the height as indicated on the project plans.

MANHOLE GENERAL CONSTRUCTION

The Packaged Metering Manhole shall have a minimum 1/2" wall thickness and be designed and manufactured in accordance with ANSI/ASTM D3753-81 Standard Specification for fiber reinforced manholes. Any portion of the flume or end adapters extending outside the manhole shall have a reinforced cover. The manhole sides, bottom and external flume sections shall be designed to withstand a static load of 150 lb./ft. per foot of depth with less than 1/4" deflection. There shall be no light duty angles of flanges protruding beyond the flume or manhole, that can be damaged by shear or load forces. The fiberglass manhole shall be fabricated with polyester resin, in one integral

piece that is structurally strong, lightweight, watertight and corrosion resistant to salt water, ground water, corrosive soil conditions and many commonly encountered industrial chemicals.

Manhole Barrel:

Fiberglass barrel shall be 48 inch. in diameter. The barrel shall have a minimum 1/2 inch thickness. Interior of barrel shall have a 15-20 mil. thick white gelcoat. Barrel manufacturer shall be the same as that of the flume and the accessories.

O.D. of collar shall be equal to O.D. of incoming and outgoing pipe.

Pipe Stubs:

The FRP manhole and flume shall be provided with pipe stubs to match the O.D. of incoming and outgoing type of pipe as shown on the project plans or accepted in the Proposal. Flume end adapters shall allow a smooth flow transition from pipe flow to flume flow.

STANDARD FLUME SIZES

Parshall 3" thru 36" (sized and Approved for use with flow over 100,000 gpd)

Palmer-Bowlus 4" thru 36"(sized and Approved for use with flow under 100,000 gpd)

Flume:

The flume shall be designed to handle a normal flow of _____(gpm/cfs) with expected peak flow _____(gpm/cfs) and minimum flow _____(gpm/cfs). The flume shall be a _____ inch. (Parshall/Palmer-Bowlus with a trapezoidal throat) flow measurement flume. Flume inside surface shall be smooth, isophthalic gelcoat of 10 - 20 mil thickness. Flume shall be constructed of orthophthalic polyester resin reinforced with fiberglass. The minimum glass content shall be 30% exclusive of gelcoat surfaces. Nominal wall thickness shall be a minimum of 1/4 inch for areas inside the barrel and 1/2 inch minimum for portions extending beyond the barrel.

The flume shall be furnished with the following :

attached 12" floatwell (left side)

T-304 stainless steel adjustable support bracket for ultrasonic level sensor over the waterway

pH probe bracket

temperature probe bracket

molded-in head gage graduated in feet and inches, right scale shall be graduated in feet and half tenths with 3/4" high black numerals at each tenth, the left scale shall be graduated in half inch with 3/4" high black numerals at each inch.

The above to accept the instrumentation of an Ultrasonic Open Channel Flow Transmitter and pH Continuous Chart Recorder, as required in the "Policies for Flowmeter Devices" and "pH Monitoring" by the City's Wastewater Division. The flume shall be bonded into the manhole to form a totally integral flow measurement manhole package. The resultant structure will be watertight. Portions of the flume extending outside the manhole shall be covered with fiberglass to assure a watertight system. The fiberglass cover shall be reinforced and of sufficient strength to withstand soil loads up to 150 lb./ft per foot of depth when buried.

Internal Ladder:

The Packaged Metering Manhole shall be furnished with an internal fiberglass ladder to provide easy access. The ladder rungs shall have a non-slip traction surface and internal stainless steel safety bar. The ladder shall meet or exceed OSHA General Industry Standards, Part 1910.27 for "Fixed Ladders".

Utility Tap

The manhole barrel shall be fitted with (give ___3___ quantity and ___3/4"___ size of access taps required), diameter FRP through-wall utility tap(s) having threaded connections to permit subgrade entrance of power, sample or recording lines without damaging the watertight integrity of the manhole. (Temporarily Plugged)

Flume Cover :

A internal fiberglass grate or cover shall be furnished to provide a walking surface and prevent debris from falling into flume channel.

INSTALLATION

General:

The Packaged Metering manhole shall be installed in accordance with the engineers specifications and local codes and in a manner consistent with the installation instructions and recommendations of the manufacturer. The contractor shall see that good construction and installation procedures are followed throughout handling, storage and

placement to insure that the manhole is not damaged in any manner, and that maximum serviceable results are achieved.

Handling and Storage:

During loading, unloading and storage care shall be exercised to insure that the manhole is not dropped or otherwise damaged through impacting with solid surfaces. The manhole shall be stored on a smooth surface, free of sharp objects, and if laid horizontally, shall be placed in such a way as to avoid structural damage to the inlet and outlet channels. Slings will be accomplished using nylon or other fabric material. Under no circumstances shall cable or chain slings be used in direct contact with fiberglass surfaces.

Site Preparation:

The site shall be excavated wide enough to accommodate the manhole and to provide a safe working environment for workers. The contractor shall provide a level concrete slab as indicated on the project plans with smooth troweled surface. Pad elevation shall be as shown on the drawings, and positioned so that the invert of manhole piping matches that of the pipeline. Pad shall be fitted/drilled with 10 count, 1/2"- 13 NC , T-304 stainless steel (wedge) anchor bolts at the location indicated on the project plans, manufacture's shop drawings, and installation instructions. Unless specified otherwise by the manufacturer, the bolt circle diameter shall be 54".

Placement and Final Installation:

Prior to manhole placement, the slab shall be cleaned of all sharp objects and debris, and the foam pad, supplied with unit, properly placed on slab. Neoprene boots supplied with unit, shall also be placed onto existing pipes before lowering manhole onto concrete slab.

Packaged Metering Manhole shall be lowered onto slab and properly located on anchor bolts in accordance with the manufacturers' written instructions and recommendations. Slip neoprene boots with stainless steel clamps over pipe ends, and tighten clamps securely. Under no circumstances shall petroleum lubricants of any type be used to install boots.

After placement on the foam pad, all anchor bolts shall be securely tightened to tie downs on packaged manhole, and the flume level shall be checked and adjusted as necessary. On larger units all open spaces under the flume shall be filled with grout to provide adequate structural support.

Backfilling: Care shall be taken to avoid uneven backfill loads on the packaged manhole. Groundwater or surface water runoff shall not be allowed to accumulate in the open excavation around a manhole which has not been completely backfilled. Backfill materials shall be placed evenly around the packaged manhole in maximum 12 inch lifts. If materials other than pea gravel or sand are to be used as fill, there shall be no soil lumps or sharp objects such as rocks, concrete or other debris larger than 1 inch in size.

All fill work will be in compliance with local codes, and shall meet the inspection standards established herein for backfilled sewer trenches.

Stable Soils: (Bearing capacity greater than 2000 lbs./sq. ft.) Native soil, 1/4" x 3/8" round aggregate gravel or sand shall be used as backfill material, and placed in accordance with the above specifications. See trench specifications for ASTM 2321 requirements.

Unstable Soils and High Water Tables: (Bearing capacity less than 2000/lbs./sq. ft.) Sand or 1/4" x 3/8" rounded aggregate, compacted, shall be used in unstable soils such as expansive clays, marsh and/or where the water table may be less than 5 ft. from finished grade. Selected backfill (same as established in trench/bedding detail for ASTM 2321, except for the round aggregate gravel or sand required in lieu of class 1A and 1B) shall be placed in maximum 12 inch lifts, a minimum of 24 inches surrounding the manhole, and compacted to 95% Standard Proctor Density up to the flat brick ledge.

Finish to Grade (for Street R/W Installations): For concentric top (eccentric preferred where available), contractor shall finish to grade using brick and mortar or precast concrete rings to construct chimney of required height. Mortar bed and first grade ring shall be firmly supported on flat, bearing shoulder of packaged manhole. Under no circumstances shall cast iron ring and cover be placed directly on the manhole.