

PART III

METHODS OF CONSTRUCTION

SECTION 100

EARTHWORK

100-1

General - Earthwork shall include all necessary clearing, grubbing, grading, and excavation for pipelines and appurtenances, backfilling, compaction, and disposal of excess excavated material all as required for the complete performance of the work for the installation of sewers, manholes, special structures, and appurtenances all as indicated on the Plans and as specified herein.

Earthwork, including grading, as referred to herein or in connection herewith, shall be construed as including any or all of the following described operations:

Clearing of the construction site; excavation of all classes and of whatever substance encountered; backfilling; fine grading as finish for unpaved areas; preparation of right of way, subgrade for pipe, structures, and paving; and performing any other similar, incidental, or appurtenant earthwork operation which may be necessary to properly complete the entire work indicated and specified.

100-2

Excavation

100-2.1

Clearing and Grubbing - Areas, where work is to be performed, shall be cleared of all trees, shrubs, rubbish, and other objectionable material of any kind which, if left in place, would interfere with the proper performance or completion of the contemplated work, would impair its subsequent use, or form obstructions therein.

Organic material from clearing and grubbing operations will not be incorporated in excavation backfill.

100-2.2

Excavation - Excavation for sewer pipe, fittings, and appurtenances shall be open trench to the depth and in the direction necessary for the proper installation of the same as shown on the Plans or as otherwise approved by the Engineer. Any water which may be encountered or may accumulate in the excavation shall be pumped out or otherwise removed as necessary to keep the bottom of the excavation free and clear of water during the progress of the work.

Tunneling may be permitted as indicated by economy of construction or necessity of preserving existing improvements. If the earth in the tunnel sloughs off, the roof of the tunnel shall be broken down, and the trench excavated as an open trench.

- 100-2.2.1 Limit of Excavation - Except by special permission of the Engineer, the maximum length of open trench shall not exceed 1,500 feet in the aggregate at any one location including excavation, construction, pipe laying and embankment. Orange County Highway Department requirements shall prevail.
- 100-2.2.2 Trench Width - The overall trench width shall not be more than sixteen inches (16") or less than twelve inches (12") wider than the largest outside diameter of the pipe to be laid therein, measured at a point twelve inches (12") above the top of the pipe exclusive of branches. Excavation and trenching shall be true to line so that a clear space of not more than eight inches (8") or less than six inches (6") in width is provided on each side of the largest outside diameter of the pipe in place. For the purpose of this article, the largest outside diameter shall be the outside diameter of the bell, on bell and spigot pipe.
- Where the trench width, measured at a point twelve inches (12") above the top of the bell of the pipe, is wider than the maximum set forth above, the trench area around the pipe shall be backfilled with Class "C" concrete to form a cradle for the pipe as shown on the Detail Drawings.
- 100-2.2.3 Bracing - The contractor shall take the necessary precautions to be consistent with the rules, orders and regulations of the Division of Industrial Safety of the State of California. Excavations shall be so braced, sheeted and supported that they will be safe, and the ground alongside the excavation will not slide or settle, and all existing improvements of any kind, either on public or private property, will be fully protected from damage. The sheeting, shoring and bracing shall be so arranged as not to place any stress on portions of the completed work until the general construction thereof has proceeded far enough to provide ample strength. Care shall be exercised in the drawing or removal of sheeting, shoring, bracing and timbering to prevent the caving or collapse of the excavation faces which are being supported.

100-2.2.4 Correction of Faulty Grades - Where excavation is inadvertently carried below subgrade and/or foundation elevations, suitable provision shall be made by the Contractor for adjustment of same, as directed by the Engineer, to meet requirements incurred by the deeper excavation beneath pipe or structures. Overdepth excavation in such locations shall be rectified by backfilling with approved and/or graded gravel, and shall be compacted to provide a firm and unyielding subgrade and/or foundation, as directed by the Engineer.

100-2.3 Grading and Stockpiling - The Contractor shall control grading in a manner to prevent water running into excavations. Obstruction of surface drainage shall be avoided and means shall be provided whereby storm and wastewater can flow uninterruptedly in existing gutters, other surface drains, or temporary drains.

100-2.4 Dewatering - The Contractor shall provide and maintain at all times during construction ample means and devices with which to promptly remove and properly dispose of all water from any source entering the excavations or other parts of the work. Dewatering shall be accomplished by methods which will ensure a dry excavation and preservation of the final lines and grades of the bottoms of excavations. Said methods may include well points, sump points, suitable rock or gravel placed below the required bedding, for drainage and pumping purposes, temporary pipe lines and other means, all subject to the approval of the Engineer.

Dewatering for the structures and pipelines shall commence when groundwater is first encountered, and shall be continuous until such times as water can be allowed to rise in accordance with the provisions of this Section. No concrete footings or floors shall be laid in water nor shall water be allowed to rise over them until the concrete or mortar has set at least eight (8) hours. Water shall not be allowed to rise unequally against walls for a period of twenty-eight (28) days. Groundwater shall not be allowed to rise around the pipe until jointing compound in the joints has set hard.

100-2.5 Granular Soil - Wherever the term "granular soil" is used in these Specifications it shall be defined as a soil having a minimum sand equivalent of 30 as determined in accordance with State of California, Division of Highways, Test No. "California 217," and not more than 20% of it will pass through a 200 mesh sieve.

100-3

Trench Bottom for Vitrified Clay Pipe:- The trench bottom shall be graded to provide a smooth, firm and stable foundation at every point throughout the length of the pipe.

At each joint in the pipe, the bottom of the trench shall be recessed in the firm foundation in such a manner as to relieve the bell of the pipe of all load, and to insure continuous bearing along the pipe barrel upon the firm foundation. Should large gravel and cobbles be encountered at the trench bottom or pipe subgrade, they shall be removed from beneath the pipe and replaced with clean granular material which shall be compacted to provide uniform support and a firm foundation. The Contractor shall be responsible for accurately shaping the pipe subgrade and fitting the bottom of the pipe to the excavation for the width shown on the "Bedding Details." Use of a drag templet shaped to conform to the outer surface of the pipe will be required if other methods do not give satisfactory results.

100-3.1

Foundations in Rock - Where rock is encountered, it shall be removed below grade and the trench backfilled with clean imported sand to provide a compacted foundation cushion with a minimum allowable thickness of three inches (3") under the outside diameter of the pipe bell.

100-3.2

Foundations in Unsuitable Material - If excessively wet, soft, spongy, unstable or similarly unsuitable material is encountered at the surface upon which the bedding material is to be placed, the unsuitable material shall be removed to a depth as determined in the field by the Engineer.

100-3.3

Foundation in Suitable Soil - Where the trench excavation and pipe foundation and/or subgrade consists of granular or sandy material, the pipe shall be bedded in the material found in the trench as hereinafter specified. In the event the trench excavation material and pipe foundation are not an acceptable granular material for bedding an imported or selected granular material shall be used for bedding. In all cases, the material to be used for pipe bedding will be subject to the approval of the Engineer.

100-4

Trench Backfill - All trenches shall be backfilled after pipe, fittings and appurtenances have been installed. Whenever a relative compaction requirement value is specified herein, the optimum moisture content and relative density shall be determined in accordance with State of California, Division of Highways, Test No. "California 216."

All wood and waste material shall be removed from excavation preparatory to backfilling. Backfill material shall be approved in all cases by the Engineer and shall be free of trash, wood, large rock, or other objectionable debris. Backfilling shall include the refilling and compacting of the fill in trenches or excavations up to the subgrade of the street or to the existing ground surface.

100-4.1

Pipe Bedding - The pipe shall be carefully bedded by hand placing and compacting and/or consolidating select or imported granular backfill material from the pipe foundation to the upper limit of the pipe zone. The pipe zone shall be considered to extend from the pipe foundation to twelve inches (12") above the top of the outside diameter of the pipe bell. Imported granular material will be used for pipe bedding when excavated materials are not suitable or when required by the bedding detail indicated on the construction Drawings.

100-4.1.1

Procedure at Pipe Zone:- Selected backfill material consisting of loose earth or sand free from stones, clods, or other deleterious material shall be placed in the trench simultaneously on each side of the pipe for the full width of the trench in layers of about six inches (6") in depth. Each layer shall be thoroughly compacted, or consolidated when approved by the Engineer, to a relative density of ninety percent (90%). Care shall be exercised in backfilling to avoid damage to the pipe.

100-4.2

Backfill above Pipe Zone - The remaining portion of the trench to within two and one-half feet (2-1/2') of the roadway surface or ground surface, as the case may be, shall be backfilled, compacted and/or consolidated by approved methods to obtain a relative density of ninety percent (90%). Backfilling shall be done with good, sound earth, sand or gravel, and no oil cake, bituminous pavement, concrete, rock or other lumpy material shall be used in the backfill, unless these materials are scattered and do not exceed six inches (6") in any dimension, and are not placed within 1-foot of the 2-1/2-foot limit. Material of a perishable, spongy or otherwise improper nature shall not be used in backfilling, and no material greater than four inches (4") in any dimension shall be placed within 1-foot of any pipe, manhole or structure.

100-4.2.1

Compaction in Open Fields - In open fields across private property within District easements, where paving or structures will not be above the excavated area, backfill above the "pipe zone" to the top of trench shall be compacted and/or consolidated by approved methods to obtain a density equal to the density of the adjacent undisturbed soil but not less than a relative density of eighty-five percent (85%). Where backfilling is to support paving or structures a compaction of ninety percent (90%) relative density shall be attained.

100-5

Backfill at Street Zone - The top two and one-half feet (2-1/2') of the trench within road bed areas shall be compacted in horizontal layers not exceeding eight inches (8") in thickness, using approved hand, pneumatic or mechanical type tampers to obtain a relative density of ninety percent (90%). Flooding and jetting will not be permitted in this upper two and one-half feet (2-1/2').

From existing street grade to two and one-half feet (2-1/2') below street grade, the material for backfill may contain stones ranging in sizes up to two inches (2") in diameter in quantity not exceeding twenty percent (20%) of the volume where said course materials are well distributed throughout the finer material and the specified compaction can be obtained.

100-6

Compaction - Compaction shall be done by use of vibratory equipment, tamping rollers, pneumatic tire rollers, or other mechanical tampers of the type and size approved by the Engineer. The backfill shall be placed in horizontal layers of such depths as are considered proper for the type of compacting equipment being used in relation to the backfill material being placed. Each layer shall be evenly spread, properly moistened and compacted to the specified relative density in paragraph 100-4.2.1. The Contractor shall repair or replace any sewer pipe, fittings, manholes, and/or structures as directed by the District where damaged by the Contractor's operations.

100-7

Consolidation - Consolidated fill shall be performed by flooding, poling, or jetting so as to obtain a relative density of the fill material at least equal to that specified in paragraph 100-4.2.1. When flooding, poling or jetting methods are used, material for use as backfill shall be placed and consolidated in layers not exceeding four feet (4') in thickness. Flooding, poling or jetting methods shall be supplemented by the use of vibratory or other compaction equipment when necessary to obtain the required relative density. Care shall be taken in all consolidating operations to prevent the movement or floating of the sewer pipe. Consolidation methods shall not be used where the backfill material is not sufficiently granular in nature to be self draining during and after consolidation, or where foundation materials may be softened or otherwise damaged by the quantities of water applied. The Contractor shall rectify any misalignment of the pipe because of consolidation operations as directed by the District.

100-8

Compaction Requirements - The Contractor will engage the services of an approved testing laboratory to determine the relative density of the backfill. The relative density shall be determined in accordance with the methods specified by the State of California, Division of Highways, Test No. "California 216".

If the backfill fails to meet the relative density requirements set forth herein, the Contractor shall rework the backfill until the requirements are complied with. The Contractor shall make all necessary excavations for density tests as directed by the Engineer. Orange County Highway Department requirements shall prevail.

100-9

Excess Excavated Material - The Contractor shall make the necessary arrangements for, and shall remove and dispose of all excess excavated material.

It is the intent of these Specifications that all surplus material not required for backfill or fill shall be disposed of by the Contractor outside the limits of the public rights of way and/or easements.

No excavated material shall be deposited on private property unless written permission from the owner thereof is secured by the Contractor. Before the District will accept the work, the Contractor shall file a written release signed by all property owners with whom he has entered into agreements for disposal of excess excavated material absolving the District from any liability connected therewith.

100-10

Imported Backfill Material - Whenever the excavated material is not suitable for backfill, the Contractor shall arrange for and furnish suitable imported backfill material, which is capable of attaining the required relative density. He shall dispose of the excess trench excavation as specified in the preceding section. The backfilling with imported material shall be done in accordance with the methods described herein.

100-11

Structure Excavation and Backfill

100-11.1

Structure Excavation - Structure excavation shall include the removal of all material of whatever nature necessary for the construction of structures and foundations in accordance with the Plans and these Specifications. The sides of excavations for structures shall be sufficient to leave at least two feet (2') in the clear as measured from the extreme outside of form work or the structure as the case may be. Where excavation is inadvertently carried below designated elevations, suitable provision shall be made by the Contractor for adjustment of construction, as directed by the Engineer, to meet requirements incurred by the deeper excavation. No earth backfill will be permitted to correct overdepth excavation beneath structures, and overdepth excavation in such locations shall be rectified by backfilling with sand, graded gravel, or concrete as directed by the Engineer.

100-11.2

Structure Backfill - After structures and foundations are in place, backfill shall be placed to the original ground line or to the limits designated on the Plans. No material shall be deposited against the walls of concrete structures for a period of fourteen (14) days following pouring of concrete.

100-11.2.1

Material - Backfill material shall consist of loose earth or sand free from stones, clods, or other deleterious material. When material from the excavation is unsuitable for use in backfill, it shall be disposed of as specified in Section 100-9 above, and suitable material, which is capable of attaining the required relative density, shall be used in its place.

100-11.2.2

Compaction - Backfill shall be placed in horizontal layers not exceeding six inches (6") in depth and shall be moistened and thoroughly tamped, rolled or otherwise compacted to a minimum relative density of ninety percent (90%) in accordance with the provisions of paragraph 100-4 above. Water settling will not be permitted except with the written permission of the Engineer.

100-12

Final Clean-Up - After backfill has been completed, the right of way shall be dressed smooth and left in a neat and presentable condition.

SECTION 101

VITRIFIED CLAY PIPE AND FITTINGS

101-1

Laying Vitrified Clay Pipe

Trenches shall be kept free of water during the laying operation and until the material in the joints has sat sufficiently to preclude any damage. All pipe shall be laid without break, upgrade from structure to structure, with the bell ends of the pipe upgrade. Pipe shall be laid to the line and grade given and in such a manner as to form a close concentric joint with the adjoining pipe and prevent sudden offsets of the flow line. The interior of the sewer pipe shall be cleaned of all dirt and superfluous materials of all description as the work progresses. The provisions of Section 100 of these Specifications shall apply to the installation of the pipe.

101-1.1

Flexible Compression Joints

The Contractor shall wipe the mating surfaces of the pipe to be joined clean of all dirt and foreign matter, and apply an approved lubricant. Then, with the surfaces properly lubricated, the Contractor shall position the spigot end of the pipe inside the bell and shove the joint home. For larger diameter pipe where a lever attachment is required the Contractor shall take the necessary precautions to insure an undamaged pipe installation.

101-1.2

Preventing Foreign Matter from Entering the Pipe

At times when the pipe laying is not in progress, the open end of the pipe shall be closed with a tight-fitting cap or plug to prevent the entrance of foreign matter into the pipe. These provisions shall apply during the noon hour as well as overnight. In no event shall the sewers be used as drains for removing water which has infiltrated into the trenches.

101-1.2.1

Branches

Vitrified clay pipe wyes, tees, and other types of branches shall be furnished and installed along with vitrified clay pipe sewer. Wyes of size specified on the Plans shall be installed for all sewer house connections and for future sewer house connections as shown on the Plans. Tees shall be installed for chimneys shown on the Plans. The longitudinal barrel of branch fittings, to be placed in-line and grade with the vitrified clay pipe sanitary sewer mains, shall be of the same diameter, quality and type as said sewer. Installation, earthwork and bedding for branches shall conform to the applicable provisions set forth for

vitrified clay sewer pipe. Tee branches shall have their axis perpendicular to the longitudinal axis of the pipe. Unless otherwise specified, the branch of wye fittings shall be inclined upward at an angle not greater than forty-five degrees (45°) from a horizontal line. If so shown on the Plans, tees with standard tee foundations shall be substituted for wye branches. No wye or tee for sewer house connections branch shall be placed closer than five feet (5') in the downstream side, to the centerline of any structure.

The Contractor shall place a support of No. 4 crushed rock under every wye branch when installed. The support shall be placed in accordance with the detail on the Plans.

101-2

Saddle Connections

All saddle connections into existing sewer lines shall be made with a collar wye saddle or a collar tee saddle for chimneys and no saddle connection smaller than four inches (4") nor larger than six inches (6") will be permitted. All connections into a 27-inch or larger sewer line shall be made at a structure.

The quality of the vitrified clay pipe saddles shall conform to the applicable provisions of Section 11 of these Specifications. Joints for the saddles shall conform to Section 11.2 of these Specifications.

101-2.1

Saddle Installation

The sewer line to be saddled shall be scored to the approximate shape of wye or tee and shall be cut with a circular ceramic saw of 2", 4", 6" and 8" diameter. The resulting opening into the sewer line shall be further worked by hand to accomplish a true and neat opening for the collar wye or tee saddle. The Contractor shall replace or repair any pipe damaged during his operation, and the Engineer shall be the sole judge as to how the repair or replacement should be accomplished.

The Contractor shall secure the collar wye or tee saddle to the sewer main with a catalytic epoxy resin as specified in Section 17 of these Specifications.

After the connection has set sufficiently long enough for the epoxy resin to cure, the District will inspect the connection and if satisfactory the Contractor shall encase the fitting with Class "A" Portland cement concrete to the limits indicated on the Detail Drawings.

The Contractor shall carry out the saddling operation only in the most workmanlike manner, and he shall keep all clay chips, dirt, epoxy, mortar, and concrete out of the sewer line being saddled. The Contractor shall, if directed to do so by the District, perform a flushing, cleaning, and balling operation of the reach of sewer main saddled.

As an alternate method of cutting an opening in the sewer line, the Contractor may chip the opening by following the procedure outlined below:

The main line sewer shall be scored to the approximate shape of the collar wye saddle or collar tee saddle. A small hole, not larger than one-inch in diameter, shall be made in the approximate center of the area to be cut from the sewer line with a pointed tool similar to a mason's pick. Then the opening shall be chipped to the scored line in a spiraling fashion with a chisel and a short handle, hand-held hammer. The Contractor shall replace or repair any pipe damaged during his operation, and the Engineer shall be the sole judge as to how the repair or replacement should be accomplished.

SECTION 102

HOUSE LATERALS

102-1

General

The Contractor shall install house laterals and wye branch fittings of the size indicated on the Plans and shall install the house laterals at the recommended location for each lot as furnished by the Owner.

The Contractor shall place as many wye branch fittings for house laterals as may be designated on the Plans. Each wye branch fitting shall have its barrel diameter equal to the diameter of the sanitary sewer main and the spur (or branch) diameter as indicated on the Plans. No wye branch shall be placed closer than five feet (5') on the downstream side, to the centerline of any structure. All wye branch fittings that are to be left unconnected shall be plugged with a vitrified clay disc stopper or plug. House laterals shall be joined to wye branch fittings at the sanitary sewer main as set forth above by eighth bends. All eighth bends and quarter bends are a part of house lateral sewer line.

Where possible all house laterals shall run perpendicular to the sewer main from the main to the property line, and all house laterals shall be bedded the same as the sewer main into which they connect.

All house laterals shall be plugged with an approved stopper in the socket of the last joint of each house lateral which shall be securely sealed in place with Sewer Joint Compound, as specified in Section 11 of these Specifications, so that it will withstand the internal pressure during the test for leakage, but also in such a manner that it may be removed without injury to the socket.

102-2

Location of House Laterals

The Contractor shall mark the location of each house lateral at its upper end by chiseling a letter "S" one and one-half inches ($1\frac{1}{2}$ ") high on the top of the curb. If the terminal point of the house lateral is more than eight feet (8') beyond the curb line or curb improvements do not exist, the Contractor shall furnish and install a wood stake at the end of the house lateral in conformance with the Detail Drawings.

Where curb improvements are installed after the house laterals are laid, and before the District accepts the sanitary sewers, the Contractor shall chisel the 1-1/2-inch "S" on the top of the curb before acceptance.

SECTION 104

MANHOLES

104-1

General

Sewer manholes shall be constructed in accordance with the Detail Drawings and of the size indicated at the locations shown on the Plans. The manholes shall be constructed of precast eccentric concrete manhole units or built-in-place brick in accordance with the Detail Drawings and these Specifications. Manholes shall be built without steps.

104-2

Manhole Base

The manhole base shall be poured in place with Type II, Portland cement concrete. The manhole stubs and sewer main shall be set before the concrete is placed and shall be rechecked for alignment and grade before the concrete has set. The various inlets and outlets to the manhole shall be located as indicated on the Plans and as detailed in the Detail Drawings. All transitions shall be smooth and of the proper radius to give an uninterrupted transition of flow. The concrete shall be Class "A" concrete with 3/4-inch maximum size aggregate and shall have a slump not greater than two inches (2"). The concrete base shall be shaped with a wood float and shall receive a hard steel trowel finish prior to the concrete setting. The bases shall set a minimum of twenty-four (24) hours before the manhole construction is continued.

104-2.1

Manhole Invert

The invert of the manhole base shall be hand worked so as to provide channels conforming in size and shape to the lower portions of the inlets and outlets. The channel shall vary uniformly in size and shape from inlet to outlet, and be constructed as indicated on the Detail Drawings. The manhole invert channels shall be smooth and accurately shaped. Channels may be formed directly in the concrete base or may consist of one-half sewer tile laid in the concrete base.

104-3

Precast Manholes

Each manhole section shall be set in a bed of mortar to make a watertight joint and shall be neatly pointed on the inside and shall be set perfectly plumb. Sections of various heights shall be used in order to bring the top of the manhole ring and cover to the elevation established by the Engineer.

The precast concrete manhole rings shall be jointed with a minimum thickness of 1/2-inch of Portland cement mortar. Mortar shall be composed of one (1) part Portland cement to two (2) parts of clean well-graded sand of such size that all pass a number eight (8) sieve. Cement, aggregate, and water for mortar shall conform to the applicable provisions of Section 12 of these Specifications.

104-4

Manhole Stubs and Stoppers - Vitrified clay pipe stubs shall be furnished and installed in manholes at the locations and in conformance with the Detail Drawings and as shown on the Plans. All stubs shall be plugged with stoppers or brick wall plugs as shown on the Plans for various sizes of pipe. Where new construction is started at the stub of an existing manhole the contractor shall brick the opening into the manhole before he removes the plug or stopper from the stub. Said bricked opening shall remain in place until the Contractor has tested and completed the work.

104-5

Watertightness of Manholes - It is the intent of these Specifications that manholes and appurtenances be as watertight and free from infiltration as possible. Where manholes are to be given a protective lining or coating, they shall be free of any seeping or surface moisture. The adequacy of manholes and appurtenances as to watertightness shall be determined by the Engineer, and shall be tested by filling with water when ordered by the Engineer.

104-6

Manhole Frame and Cover - The elevations at which manhole frames and covers are to be set shall conform to the requirements set forth on the Plans and Detail Drawings but in all cases shall be governed by the Engineer in the field. Where the frame and cover are in existing pavement or in the traveled way of the existing road shoulder, it is to be placed flush with the existing surface. Where the structure is outside the limits of the traveled shoulder but not in the roadside ditch, it should be placed 1/10-foot or more above the existing ground surface. Where the manhole cover falls in the existing roadside ditch or right-of-way, it is to be placed approximately 1-1/2 foot above the existing ground surface or as directed by the Engineer. Manhole frames shall be set at the required grade and shall be securely attached to the top precast manhole shaft unit with a cement mortar bed and fillet as shown on the Plans. After the frames are securely set in the place provided herein, covers shall be installed and all necessary cleaning and scraping of foreign materials from the frames and covers shall be accomplished to insure a fine satisfactory fit.

SECTION 105

STEEL CASING PIPE

- 105-1 General - Steel casing pipe shall be installed at the locations and to the lines and grades indicated on the Plans and as herein specified. All work shall conform to the specifications and requirements of the State of California, Division of Highways, the Orange County Highway Department, the City, and/or the railroad company involved. It shall be the Contractor's responsibility to secure all necessary permits for start and prosecution of casing pipe installation.
- 105-1.1 Installation
- 105-1.1.1 General - The equipment, materials and methods used for the construction of the complete installation of the casing pipe and the sewer pipe within the casing shall be determined by the Contractor to the extent that the final and completed installation receives the approval of the Engineer and is consistent with the intent of these Specifications.
- The Contractor may present an alternate detailed proposal in lieu of the methods and materials specified herein to jack or bore casing pipe under the locations as shown on the Plans. Such proposal shall be subject to the sole approval of the Engineer and shall be presented FOURTEEN (14) CALENDAR DAYS in advance of the work to allow adequate time for checking and must be in accordance with all the conditions set forth in the necessary permits.
- 105-1.1.2 Jacking and Boring - Steel casing pipe of the minimum size and thickness specified herein, shall be installed in place by jacking and/or boring methods without the use of water or air at the locations shown on the Plans, and to grades required to install the vitrified clay carrier pipe. The Contractor's attention is called to the fact that extreme care will be required in placing the casing pipe so as to permit the construction of the sewer pipe to the lines and grades shown on the Plans. The sewer mains are gravity flow, designed at grades which will not permit variance from the lines and grades as shown. It shall be the Contractor's responsibility for choosing a size of casing, at or above the minimum specified, in order that the jacking may be done with a sufficient degree of accuracy to permit installation of the vitrified clay carrier pipe to the grades shown on the Plans.

In general, excavated material shall be removed from the casing as jacking progresses and no accumulation of excavated material within the casing will be permitted. Should appreciable loss of ground occur, the voids shall be back-packed promptly to the extent practicable with soil cement. Upon completion of the jacking operation and before the carrier pipe is installed, all voids around the casing shall be filled by grouting through holes drilled through the casing. The grout shall be a lean mixture of sand and cement placed at low pressures. After the carrier pipe has been installed, the annular space between the carrier pipe and the casing pipe shall be backfilled with lean grout under pressure. Sand will not be permitted for such backfilling. Lean grout shall be one (1) part of Portland cement to not more than four (4) parts of sand by volume. Grout at each end of the casing pipe shall be finished neat and flush with pipe end.

105-2

Carrier Pipe within Casing Pipe - Vitrified clay sewer pipe conforming to the Specifications of Section II, shall be installed within the casing pipe to the lines and grades shown on the Plans. Mechanical compression joints shall be used on all vitrified clay sewer carrier pipe installed within casing pipe. The carrier pipe shall be supported on wood or metal skids prior to backfilling in such a manner as to relieve the pipe bells from all load and bearing. Prior to backfilling as specified above, said sewer carrier pipe shall pass a successful test for leakage as provided in Section 109.

SECTION 106

CONCRETE ENCASEMENT

106-1

General - Encasement concrete shall be either reinforced or non-reinforced, unformed or rough formed, and the Class as designated on the Plans. Concrete used for encasing, cradling, bedding, or cover for pipe, or other objects shall be as shown on the Plans and Detail Drawings or as directed by the Engineer.

SECTION 107

REMOVAL AND RESURFACING OF STREET PAVEMENT AND SURFACES

107-1

General - Street pavement and surfaces shall be removed and replaced in all areas of construction excavation in conformance with details shown on the Plans and as specified herein. Resurfacing of existing pavement and surfaces damaged or removed in connection with the construction of sanitary sewer improvements, including all appurtenances, shall conform to the provisions of permits issued by the State of California, Division of Highways, Orange County Highway Department, or the City, for the work within the rights of way of respective agency. In the absence of specific designation upon the Plans, the trench or excavation shall be resurfaced with the class of surfacing conforming most nearly to the surface of the street, and in accordance with the requirements, and to the full satisfaction of the agency issuing the permit.

The Contractor shall take precautions to prevent damage to all pavement and other surfaces outside the limits of necessary excavation, whether in City, County, or State right of ways, District right of ways, or private property. All damaged pavement and surfaces within City, County, or State right of ways shall be replaced in accordance with the conditions of the permits issued for the construction within the respective right of ways. The Contractor shall bear all expense in acquiring, and resulting from compliance with any and all conditions of the permits issued by the City, Orange County Road Department, and/or the State Division of Highways.

SECTION 108

RAILROAD CROSSINGS

108-1

General - The Contractor shall perform the work for the installation of the sewer lines under railroad tracks and across railroad right of way in accordance with the directions and under the supervision of the railroad company on whose property the work is done. It shall be the Contractor's responsibility to secure all necessary permits for start and prosecution of construction work on railroad property from the railroad company involved.

SECTION 109

TESTING

109-1

TEST FOR LEAKAGE AND INFILTRATION

109-1.1

General - For Either V.C.P. or Plastic Sewer Pipe - It is the intent of the plans and specifications that the completed sewer pipes of all types along with manholes and other appurtenances shall be watertight. Each section of sewer between two successive manholes shall be tested for leakage or, at the option of the District Inspector, for infiltration, or both. In general, the leakage test shall be made on all sections of sewer except those where, in the opinion of the District Inspector, excessive groundwater is encountered.

Where excessive groundwater is encountered, the infiltration test shall be made. Even though a section may have previously passed the leakage or infiltration test, each section of sewer shall be tested subsequent to the last backfill compacting operation if, in the opinion of the District Inspector, heavy compaction equipment or any of the operations of the Contractor or others may have damaged or affected the structural integrity or watertightness of the pipe, structure, and appurtenances. The Contractor shall furnish all materials required for the tests. Tests shall be made in the presence of the District Inspector.

Official inspector's test will not be made until after all the other utilities have been installed and their trench compaction verified.

If the leakage or infiltration rate as shown by the tests specified herein is greater than the amount specified, the pipe joints shall be repaired or, if necessary, the pipe shall be removed and relaid by the Contractor. The sewer will not be considered acceptable until the leakage or infiltration rate, as determined by test, is less than the maximum allowable.

109-1.2

Type Tests for V.C.P. - The following tests shall be applied to V.C.P.:

- (1) Air Test Procedure. Each section of sewer between two successive manholes shall be tested by plugging all pipe outlets with suitable test plugs. Air shall be slowly added until the internal pressure is raised to 4.0 psig. The compressor used to add air to the pipe shall have a blow-off valve set at 5 psig to ensure that at no time the internal pressure in the pipe exceeds 5 psig. The internal pressure of 4 psig shall be maintained for at least two minutes to

allow the air temperature to stabilize, after which the air supply shall be disconnected and the pressure allowed to decrease to 3.5 psig. The time in minutes that is required for the internal air pressure to drop from 3.5 psig to 2.5 psig shall be measured, the results compared with the minimum permissible pressure holding times for runs of single pipe diameter, and for systems of 4- and 6-inch laterals in combination with trunk lines are indicated in the following tables in seconds.

If the pressure drop from 3.5 psig to 2.5 psig occurs in less time than the above-tabulated or calculated values, the pipe shall be overhauled and, if necessary, replaced and relaid until the joints and pipe shall hold satisfactorily under this test.

- (2) Test for Infiltration. If in the construction of a section of the sewer between structures groundwater is encountered, the end of the sewer at the upper structure shall be closed sufficiently to prevent the entrance of water and pumping of groundwater shall be discontinued for at least three days, after which the section shall be tested for infiltration. The infiltration shall not exceed 0.025 gpm per inch of diameter per 1,000 feet of main line sewer being tested not including the length of house laterals entering that section. Where any infiltration in excess of this amount is discovered before completion and acceptance of the sewer, the sewer shall be immediately uncovered and the amount of infiltration reduced to a quantity within the specified amount of infiltration, before the sewer is accepted, at the expense of the Contractor. Should, however, the infiltration be less than the specified amount, the Contractor shall stop any individual leaks that may be observed when ordered to do so by the District Inspector. All tests must be completed before the street or trench is resurfaced, unless otherwise determined by the District Inspector.

SOFT AIRE TEST TABLE

MINIMUM HOLDING TIME IN SECONDS REQUIRED FOR PRESSURE TO DROP FROM 34 TO 24 PSID

PIPE DIAMETER

	4"	4"	6"	10"	12"	15"	18"	21"	24"	27"	30"	33"	36"	39"
25	4	10	18	28	40	62	89	121	158	200	248	299	356	418
50	9	20	35	55	79	124	178	243	317	401	495	599	713	837
75	13	30	53	83	119	186	267	364	475	601	745	898	1070	1265
100	18	40	70	110	158	248	356	485	634	785	951	1135		
125	22	50	88	138	198	309	444	595	780					
150	26	59	106	165	238	371	510							
175	31	69	123	193	277	425								
200	35	79	141	220	317									
225	40	89	158	248	340									
250	44	99	176	275										
275	48	109	194	283										
300	53	118	211											
350	62	139	227											
400	70	156												
450	79	170												
500	88													
550	97													
600	106													
650	113	170	217	283	340	425	510	595	660	765	851	933	1020	1105

NOTES: TO BE USED WHEN TESTING ONE DIAMETER ONLY

LENGTH OF MAIN LINE IN FEET

6" DIAMETER

LENGTH OF LATERAL IN FEET
4" DIAMETER

	25	50	75	100	125	150	175	200	225	250	275	300	400	500
25	14	24	34	44	54	64	74	84	94	103	113	123	163	168
50	19	29	39	48	58	68	78	88	98	108	118	128	166	167
75	23	33	43	53	63	73	83	92	102	112	122	132	164	165
100	28	37	47	57	67	77	87	97	107	117	127	136	162	163
125	32	42	52	62	72	81	91	101	111	121	131	141	160	162
150	36	46	56	66	76	86	96	106	116	125	135	145	159	161
175	41	51	61	70	80	90	100	110	120	130	140	150	157	159
200	45	55	65	75	85	95	105	114	124	134	144	153	156	158
225	50	59	69	79	89	99	109	119	129	139	149	151	154	157
250	54	64	74	84	94	103	113	123	133	143	149	150	153	156
275	58	68	78	88	98	108	118	128	138	146	147	149	152	155
300	63	73	83	92	102	112	122	132	142	145	146	147	151	154
350	72	81	91	101	111	121	131	140	141	143	144	145	149	152
400	80	90	100	110	120	130	136	138	139	141	142	143	147	150
450	89	99	109	119	129	132	134	136	138	139	141	142	145	149
500	98	108	118	126	129	131	133	135	136	138	139	140	144	147

LENGTH OF MAIN LINE IN FEET

6" DIAMETER

LENGTH OF LATERAL IN FEET
4" DIAMETER

	25	50	75	100	125	150	175	200	225	250	275	300	400	500
25	22	40	57	75	92	110	128	145	163	180	198	216	223	224
50	26	44	62	79	97	114	132	150	167	185	202	218	220	221
75	31	48	66	84	101	119	136	154	172	189	207	214	217	219
100	35	53	70	88	106	123	141	158	176	194	209	211	214	216
125	40	57	75	92	110	128	145	163	180	198	206	207	211	214
150	44	62	79	97	114	132	150	167	185	201	202	204	209	212
175	48	66	84	101	119	136	154	172	189	197	199	201	206	210
200	53	70	88	106	123	141	158	176	192	194	197	199	204	208
225	57	75	92	110	128	145	163	180	199	192	194	196	202	206
250	62	79	97	114	132	150	167	183	186	189	191	193	200	204
275	66	84	101	119	136	154	172	181	184	187	189	191	198	202
300	70	88	106	123	141	158	174	178	181	184	187	189	196	200
350	79	97	114	132	150	166	170	174	177	180	183	185	192	197
400	88	106	123	141	157	162	166	170	174	176	179	181	189	194
450	97	114	132	148	154	159	163	167	170	173	176	178	186	191
500	106	123	140	146	151	156	160	164	167	170	173	175	183	189

		LENGTH OF MAIN LINE IN FEET											8" DIAMETER		
		25	50	75	100	125	150	175	200	225	250	275	300	400	500
LENGTH OF LATERAL IN FEET 6" DIAMETER	25	28	45	63	80	98	116	133	151	168	186	204	221	224	225
	50	37	55	73	90	108	126	143	161	178	196	214	220	222	223
	75	47	65	83	100	118	135	153	171	188	206	217	217	220	221
	100	57	75	93	110	128	145	163	181	198	214	214	215	218	220
	125	67	85	102	120	138	155	173	190	208	211	212	213	216	218
	150	77	95	112	130	148	165	182	200	207	209	210	211	214	217
	175	87	105	122	140	157	175	192	204	206	207	208	209	213	215
	200	97	114	132	150	167	185	201	202	204	205	206	207	211	214
	225	107	124	142	160	177	195	199	201	203	204	205	206	210	213
	250	117	134	152	169	187	195	198	199	201	202	203	204	209	212
	275	127	144	162	179	192	194	196	198	200	201	202	204	208	210
	300	136	154	172	187	190	192	195	196	198	200	201	202	207	209
	350	156	174	181	185	187	190	193	194	196	198	199	200	205	208
	400	173	178	181	184	186	189	191	192	194	196	197	198	203	206
	450	173	177	180	183	185	187	189	190	192	194	195	196	201	204
500	173	177	180	182	184	186	188	189	191	192	193	194	200	203	

		LENGTH OF MAIN LINE IN FEET											10" DIAMETER		
		25	50	75	100	125	150	175	200	225	250	275	300	400	500
LENGTH OF LATERAL IN FEET 6" DIAMETER	25	32	49	67	84	102	119	137	154	172	189	207	224	230	230
	50	36	64	81	98	115	132	149	166	183	200	217	234	241	241
	75	41	68	85	102	119	136	153	170	187	204	221	238	245	245
	100	45	73	90	107	124	141	158	175	192	209	226	243	250	250
	125	50	77	94	111	128	145	162	179	196	213	230	247	254	254
	150	54	81	98	115	132	149	166	183	200	217	234	251	258	258
	175	58	86	103	120	137	154	171	188	205	222	239	256	263	263
	200	63	90	107	124	141	158	175	192	209	226	243	260	267	267
	225	67	95	112	129	146	163	180	197	214	231	248	265	272	272
	250	72	99	116	133	150	167	184	201	218	235	252	269	276	276
	275	76	103	120	137	154	171	188	205	222	239	256	273	280	280
	300	80	108	125	142	159	176	193	210	227	244	261	278	285	285
	350	89	117	134	151	168	185	202	219	236	253	270	287	294	294
	400	98	125	142	159	176	193	210	227	244	261	278	295	302	302
	450	107	134	151	168	185	202	219	236	253	270	287	304	311	311
500	116	143	160	177	194	211	228	245	262	279	296	313	320	320	

		LENGTH OF MAIN LINE IN FEET											10" DIAMETER		
		25	50	75	100	125	150	175	200	225	250	275	300	400	500
LENGTH OF LATERAL IN FEET 6" DIAMETER	25	37	65	92	120	147	175	202	230	257	277	278	278	279	280
	50	47	75	102	130	157	185	212	240	267	271	272	273	276	277
	75	57	85	112	140	167	195	222	250	265	266	267	269	272	274
	100	67	95	122	150	177	205	232	257	260	262	263	265	269	271
	125	77	105	132	160	187	215	242	253	255	257	259	261	266	269
	150	87	114	142	169	197	224	245	248	251	254	256	257	263	266
	175	97	124	152	179	207	234	241	245	248	250	252	254	260	264
	200	107	134	162	189	217	233	237	241	244	247	249	251	258	262
	225	117	144	172	199	225	230	234	238	241	244	246	248	255	260
	250	127	154	182	209	222	227	231	235	238	241	243	246	253	258
	275	136	164	191	213	219	224	229	232	236	238	241	243	251	256
	300	146	174	201	211	217	222	226	230	233	236	239	241	249	254
	350	166	192	200	207	212	217	222	226	229	232	235	237	245	250
	400	181	190	197	203	209	214	218	222	225	228	231	233	241	247
	450	180	188	195	201	206	211	215	219	222	225	227	230	238	244
500	179	186	193	198	203	208	212	215	219	222	224	227	235	241	

		LENGTH OF MAIN LINE IN FEET											12" DIAMETER		
		25	50	75	100	125	150	175	200	225	250	275	300	400	500
LENGTH OF LATERAL IN FEET 4" DIAMETER	25	44	84	123	163	202	242	282	321	332	333	334	334	336	336
	50	48	88	128	167	207	246	296	323	324	326	327	328	331	333
	75	53	92	132	172	211	251	290	316	317	319	321	323	327	329
	100	57	97	136	176	216	255	295	308	311	313	316	317	323	326
	125	62	101	141	180	220	260	297	301	304	308	310	312	319	323
	150	66	106	145	185	224	264	290	295	299	302	305	308	315	319
	175	70	110	150	189	229	258	283	289	293	297	300	303	311	316
	200	75	114	154	194	233	271	277	283	288	292	296	299	308	313
	225	79	119	158	198	238	265	272	278	283	288	291	295	304	310
	250	84	123	163	202	242	259	267	273	278	283	287	291	301	308
	275	88	128	167	207	244	254	262	269	274	279	283	287	298	305
	300	92	132	172	211	239	249	257	264	270	275	279	283	295	302
	350	101	141	180	218	231	241	249	256	262	268	272	276	289	297
	400	110	150	189	210	223	233	242	249	255	261	266	270	283	292
	450	119	158	189	204	216	227	235	243	249	255	260	264	278	288
500	128	166	184	198	210	221	229	237	243	249	254	259	273	283	

		LENGTH OF MAIN LINE IN FEET											12" DIAMETER		
		25	50	75	100	125	150	175	200	225	250	275	300	400	500
LENGTH OF LATERAL IN FEET 6" DIAMETER	25	50	89	129	168	208	248	287	327	331	332	333	333	335	336
	50	59	99	139	178	218	257	297	321	323	325	326	327	330	332
	75	69	109	149	188	228	267	307	314	316	318	320	321	326	328
	100	79	119	158	198	238	277	302	306	309	312	314	316	321	325
	125	89	129	168	208	248	287	295	300	303	306	309	311	317	321
	150	99	139	178	218	257	284	289	294	298	301	304	306	314	318
	175	109	149	188	228	267	278	284	289	293	296	299	302	310	315
	200	119	158	198	238	265	272	278	284	288	292	295	298	306	312
	225	129	168	208	248	250	268	274	279	284	288	291	294	303	309
	250	139	178	218	246	255	263	269	275	280	284	287	290	300	306
	275	149	188	228	242	251	259	266	271	276	280	284	287	297	304
	300	158	198	227	238	248	255	262	268	272	277	281	284	294	301
	350	178	208	221	232	241	249	255	261	266	271	274	278	289	296
	400	189	204	217	227	236	243	250	256	261	265	269	273	284	292
	450	187	201	213	223	231	239	245	251	256	260	264	268	279	288
500	186	199	210	219	227	234	240	246	251	256	260	263	275	284	

Type Tests for Plastic Sewer Pipe - The following tests shall be applied to plastic sewer pipe:

- (1) Air Testing. The duration permitted for a prescribed low pressure air exfiltration pressure drop between two consecutive manholes shall be not less than that shown below. The prescribed drop shall not exceed 0.5 psi from 3.5 to 3.0 psi in excess of the groundwater pressure above the top of the sewer.

MINIMUM DURATION FOR AIR
TEST PRESSURE DROP

<u>Pipe Size</u> <u>(inches)</u>	<u>Time</u> <u>(minutes)</u>
4	2-1/2
6	4
8	5
10	6-1/2
12	7-1/2
15	9-1/2

- (2) Infiltration Testing. Infiltration testing shall be an acceptable method of leakage test only when the groundwater level is above the top of the pipe throughout the length being tested. The allowable infiltration for any portion of sewer system shall be measured by a weir or current meter placed in the appropriate manhole and shall not exceed 50 gallons per inch of internal pipe diameter per mile per day.
- (3) Exfiltration Testing. Exfiltration testing is an acceptable method of test only in dry areas or when the groundwater level above the pipe is suitably low. The allowable water exfiltration for any length of sewer pipe between manholes shall be measured and shall not exceed 50 gallons per inch of internal pipe diameter per mile of pipe per day. During exfiltration testing, the maximum internal pipe pressure at the lowest end shall not exceed 25 feet of water or 10.8 psi and the internal water head shall be 2 feet higher than the top of the pipe or 2 feet higher than the groundwater level, whichever is greater.

Manhole Test - Watertightness of manholes may be tested in connection with tests of sanitary sewers or at the time the manhole is completed and backfilled. The Contractor shall plug all inlets and outlets with approved stoppers or plugs and fill the manhole to the limits indicated below. Any evidence of leakage as a result of testing shall be repaired to the satisfaction of the District Inspector.

The manhole shall be filled with water to 1 foot below the start of the cone section with a minimum depth of 4 feet and a maximum depth of 20 feet.

The water shall stand in the manhole for a minimum of one hour to allow the manhole material to reach maximum absorption. After the one-hour period has elapsed, the Contractor shall refill the manhole to the original depth and the drop in water surface shall be recorded after a period of from 15 minutes to one hour has elapsed, time of the test being determined by the District Inspector and varied by the District Inspector to fit the various field conditions.

The maximum allowable drop in the water surface shall be 1/2 inch for each 15-minute period of testing. Even though the leakage is less than the specified amount, the Contractor shall stop any leaks that may be observed to the satisfaction of the District Inspector.

109-1.5

Test for Damaged or Defective V.C.P. in Place - After the pipe has been installed and tested, and the compacted backfill placed, but after manholes are raised to grade and resurfacing is completed, the pipe shall be balled from manhole to manhole with a sewer scrubbing ball of a type and size to be approved by the District Inspector. In addition to and after balling the pipe, all straight sewers and inlet and outlet ends of curvilinear sewers shall be mirrored by the District Inspector with the assistance of the Contractor's forces. All balling and mirroring shall be done in the presence of the District Inspector and shall constitute tests for alignment, grade, damage, or defective pipe in place, or any other type of faulty installation. Should balling and mirroring indicate any faulty installation of the pipe, repairs or replacements shall be made by the Contractor as directed by the District Inspector.

109-1.6

Test for Damaged or Defective Plastic Sewer Pipe in Place - Following the placement and densification of backfill and prior to the placing of permanent pavement, all main line pipe shall be cleaned and then mandrelled to measure for obstructions (deflections, joint offsets, and lateral pipe intrusions). A rigid mandrel shall be pulled through the pipe by hand. The mandrel shall have a cross section equivalent to a circle having a diameter of at least 95% of the specified average inside diameter for PVC and ABS solid wall pipe and 96% for ABS composite pipe. The minimum length of the circular portion of the mandrel shall be equal to the nominal diameter of the pipe.

Obstructions encountered by the mandrel shall be corrected by the Contractor.

All material, equipment, and labor to perform the test shall be provided by the Contractor at no cost to the District.