

SECTION 13 EARTHWORK

13-01 Description. Earthwork shall consist of performing all operations necessary to excavate earth, rock and/or other materials from the trench or excavation; to excavate all material, of whatever nature, necessary for the construction of foundations for structures, sewers, and drainage facilities; to construct embankments; to place backfill around structures, sewers and drainage facilities; and over sewers, culverts and drainage pipes; to backfill ditches, holes, pits and other depressions within the work area; to construct temporary and permanent trench surfacing; to remove unsuitable material and replace with suitable material; to construct earth protection dikes.

13-02 Encroachment Permits. For all work within public right of ways, the Contractor shall secure all necessary encroachment permits from the agencies having jurisdiction and shall comply with all requirements of the encroachment permits.

13-03 Compaction. Compaction of materials shall be defined as follows:

- A. Relative Compaction refers to compaction of soil and aggregate base as defined by ASTM 1557-78.
- B. Relative Density refers to the density of crushed rock as defined by ASTM D 2049-69.

13-04 Materials The Contractor shall provide and install all materials as shown on the drawings and/or as specified herein and as defined herein below.

- A. Crushed Rock - Crushed rock shall be hard, sound and durable and shall not slake or disintegrate in water. One and one-half inch (1-1/2") crushed rock shall be uniformly graded with one hundred percent (100%) passing a 1-1/2" sieve and not more than five percent (5%) passing a 3/8" sieve. Three-quarter inch (3/4") crushed rock shall be uniformly graded with one hundred percent (100%) passing a 3/4" sieve and not more than five percent (5%) passing a 1/4" sieve.
- B. Class 2 Aggregate Base - Class 2 aggregate base shall conform to Section 26, Aggregate Bases, of the State Standard Specifications, Paragraph 26-102 A. The grading shall be 3/4" maximum.
- C. Lightweight Rock Fill - Lightweight rock fill shall weigh 60 pounds per cubic foot or less when compacted to 90% relative compaction. The rock sizes can be either 3/4 inch or 1-1/2 inch, except that within 6 inches of the slab, the rock size shall be 3/4 inches. The rock shall be compacted in 12-inch lifts with a lightweight vibratory compactor.

- D. Slurry Cement Backfill - Slurry Cement Backfill composition and placement shall conform to Section 19 of the State Standard Specifications, Paragraph 19-3.06 B.

Slurry Cement Backfill shall be used to backfill any undermined areas and may be used as an alternate to Class 2 aggregate base for intermediate backfill to grade. Care shall be taken not to disturb the Slurry Cement Backfill after placement.

- E. Structural Fill - Structural fill when specified for fill or structural backfill shall consist of excavated on-site soil and/or imported material (not bay mud). Excavated on-site soil or imported material to be used as structural fill shall be so prepared that it is free of unsuitable material as defined herein in Paragraph 13-04 F. and shall have a plasticity index of 20 or less and a liquid limit of 40 or less. Structural fill shall be capable of being compacted to the required relative compaction. A sample of the material shall be submitted for approval by the District prior to placement.
- F. Unsuitable Material - Unsuitable material is material containing debris, roots, wood, vegetable matter, scrap metal, asphalt, plastic and rocks over 6" in greatest dimension.
- G. Topsoil - Topsoil shall be imported commercially manufactured, fertile, friable, natural, productive soil containing a normal amount of humus and capable of sustaining healthy plant life. Topsoil shall be free of subsoil, heavy or stiff clay, rocks, gravel, brush, roots, weeds, noxious seeds, sticks, trash, and other deleterious substances. Soil shall not be infested with nematodes or with other noxious animal life or toxic substances. Soil shall be obtained from well-drained, arable land and shall be of an even texture. Soil shall not be taken from areas on which are growing any noxious weeds, such as Morning Glory, Sorrel, or Bermuda Grass.
- H. Water - Water used for dust control and moisture conditions for compaction shall be reasonably free of objectionable quantities of silt, oil organic matter, alkali, salts and other impurities as determined by the District. Bay water or water from drainage ditches on the project site shall not be used. If available, reclaimed wastewater conforming to Health Department Requirements shall be used.

13-05 Trench Excavation and Backfill.

- A. Trench Excavation - Trench excavation shall include the removal of all materials or obstructions of any nature, the installation and removal of all sheeting and bracing, and the control of water necessary to construct the work as shown on the plans. Excavation for sewers shall be made only after pipe and other necessary materials are delivered on the site of the work. After such delivery, trench excavation shall proceed as rapidly as possible and the pipe installed and the trench backfilled without undue delay. The District shall have the authority to limit the amount of trench to be opened or left open at any one time. In public street areas, excavation and pipe laying shall be coordinated to the end that a minimum of interference with public traffic will result.

In public street areas, excavation and pipe laying shall be coordinated so that the trench at the end of each day shall not be excavated for more than fifty (50) feet in advance of pipe laying, nor left unfilled for more than fifty (50) feet where the pipe has been laid for a total of one hundred (100) feet of trench under construction at any one time. During non-working hours, all trenches in public streets shall either be backfilled and temporarily paved or shall be shored and covered with steel plates suitable to carry H-20 traffic loads. The District may require the Contractor to submit engineering calculations demonstrating that the steel plates meet this requirement.

All temporary steel trench traffic plates shall be secured and flat on the road surface. Trench plates shall overlap the existing pavement by a minimum of 18" on each side of the excavation and shall be properly beveled with compacted AC at all edges to make a smooth surface between street level to steel plates for all traffic, including pedestrian, bicycles, skate boards, etc. All trenches and excavations shall be properly braced and shored before steel plates are placed. Lighted barricades and signs warning of uneven pavement shall be placed on either side of traffic plates.

Unless otherwise permitted by the Encroachment Permit, where trenching occurs in paved areas, the pavement shall be blade cut or scored and broken ahead of the trenching operations, and shall be saw cut (using a concrete saw) to a neat edge after backfilling and prior to paving. The proper tools and equipment shall be used in marking and breaking so that the pavement will be cut accurately and on neat lines parallel to the trench. Any pavement damaged outside these lines shall be re-cut along lines as directed by the District or agency having jurisdiction and restored at the expense of the Contractor.

Trenching may be accomplished by use of trenching machines, except where their use will result in damage to existing facilities. Trenching for all pipe shall, unless otherwise specified, be open cut to the lines and grades shown on the plans except those sections specifically indicated on the plans or designated by the District to be tunneled to protect existing trees or structures.

When the Contractor is digging in the vicinity of a sewer or utility, he shall carefully pothole, i.e., expose, for the sewer or utility.

Trenches shall be excavated below the barrel of the pipe to be installed and the bottom refilled with approved bedding material (as shown in the Typical Trench Section (SD 4)).

- B. Trench Width - The allowable width of trench shall be as shown in the Typical Trench Section (SD 4). Where shoring is required, the width of the trench shall be increased only by the thickness of the sheathing.

Trenches shall be excavated with full depth vertical sides where possible. Minimum vertical trench shall be from pipe flow line to a point two (2) feet above the top of pipe. Whenever the maximum allowable trench width is exceeded for any reason, the Contractor will be required, at his expense, to install special pipe, and/or concrete encasement, and/or special backfill as directed by the District.

- C. Trench Bracing - Excavations shall be adequately shored and braced as necessary to protect workmen, so that the earth will not slide, move or settle and so that all existing improvements of any kind will be fully protected from damage.

The Contractor shall furnish, install, and maintain such sheet piling, timbering, lagging, and bracing, as necessary to support the sides of the trench. The protection of adjacent structures from movement of the ground and the elimination of the element of danger to life, property, or to existing improvements is the intent of this requirement.

All such piling, timbering, lagging, and bracing shall, unless otherwise required by the District, be removed during backfilling in such a manner as to prevent any movement to the ground or damage to the piping or other structures. When sheet piling, lagging, and bracing is left in place, such materials shall be cut off where designated and the upper part withdrawn.

Undisturbed material outside the planned excavation slopes, which is unstable and constitutes a potential slide, and material which has already come into the excavation, shall be removed.

The Contractor alone shall be responsible for the safety of his workmen and adjacent improvements and property. All shoring shall comply with Federal and State Safety Orders. Attention is directed to the "Trench Construction Safety Orders" of the California State Industrial Accident Commission which the Contractor is required by law to obey, and which are adopted by reference as a part of these specifications.

- D. Control of Water - The Contractor shall remove all water which may accumulate in the excavation during the progress of the work so that all work can be done in a dry trench. The Contractor shall at all times have on hand sufficient pump equipment and machinery in good working condition for all ordinary emergencies and shall have available at all times competent mechanics for the operation of all pumping equipment. Trenches or other excavations shall be kept free from water while the pipe or structures are being installed, while concrete is setting, and until backfill has progressed to a sufficient height to anchor the work against possible flotation or leakage.

Water from excavations and trenches shall be disposed of in such a manner as to comply with all applicable Federal, State and local laws and regulations.

- E. Temporary Diversion of Sewage. The Contractor shall maintain the flow of sewage past the work area at all times. Where the new sewer line is constructed in the alignment of the existing sewer, the Contractor shall pump the sewage around the work area during working hours. During nonworking hours, a temporary connection shall be made from the existing sewer to the new sewer. Laterals and sewers crossing the trench shall be temporarily reconnected until they can be connected to the new sewer. Discharge or bypassing of sewage to waterways is not permitted.
- F. Disposal of Excess Excavated Material - All material excavated in streets, roadways, and rights-of-way, which is determined to be unsuitable for use as backfill or in excess of the amount required for backfilling, shall be removed immediately and disposed of at a legal disposal site. No stockpiling of excavated materials will be allowed at any time in public right of ways areas.

Where excavated material is specifically permitted to be used for backfill, it shall be laid away from the side of the trench to prevent caving or undue loading on the shoring and kept trimmed up so as to cause as little inconvenience as possible to the normal use of adjacent properties. Free access must be provided to all fire hydrants, water gates, meters, and private drives. Drainage ways shall be kept clear unless other provisions are made for handling drainage. In bay mud areas, excavated material must be kept well away from the edge of the trench to prevent heaving of the bottom of the trench.

- G. Unsuitable Material - In advance of placing sewer pipe or structures, existing material within the area where such pipe or structures are to be placed, which is unsuitable as a foundation for the pipe, including but not limited to bay mud, soft material, vegetable matter, garbage and junk piles, either on the surface or buried, shall be removed and disposed of at a legal disposal site.

In rock excavation or a mixture of rock and earth excavation, such material shall be loosened and broken up for the full width of the trench so that no ribs, rocks, or solid projections will be within six (6) inches of the sewer pipe. The material thus broken up shall be removed and disposed of and the resulting space refilled with approved bedding material.

When unsuitable material is removed, the resulting space shall be refilled with 3/4" crushed rock or other approved material. In bay mud, 1-1/2" crushed rock shall be used to replace the unsuitable material.

- H. Pipe Bedding and Pipe Zone Backfill - All pipelines shall be bedded in an approved bedding material as shown on Standard Drawing SD 4. The pipe bedding and pipe zone backfill material shall be placed uniformly on each side of the pipe to prevent displacement. In wet or unstable bedding conditions, 3/4" or 1-1/2" crushed rock shall be used.

All bedding materials shall be compacted to a minimum of ninety percent (90%) relative compaction, and materials shall be carefully handled to prevent intrusion of foreign materials.

Bedding and pipe zone material for main sewers shall be an approved granular material, free from vegetable matter and other deleterious substances, graded so that it will compact readily to form a firm, stable base when compacted, as shown on Standard Drawing SD 4. The use of sand for a pipe bedding or pipe zone backfill is not permitted.

Bedding material for building sewers shall be select granular material excavated from the trench, free of any organic matter, large clods or rocks. If the excavated material is determined to be unsuitable for bedding or pipe zone backfill, material similar to that specified above for main sewers shall be used.

The Contractor shall construct four (4) foot wide dams in pipe bedding and pipe zone backfill at 400-foot intervals using compacted clay or slurry cement backfill.

- I. Intermediate Backfill - Intermediate backfill material shall consist of imported material or material excavated from the trench. All intermediate backfill material shall be free from vegetable matter, concrete, stones or clods larger than four (4) inches in diameter and other deleterious substances. The intermediate backfill material shall contain sufficient fines so that all voids will be filled when compacted, and shall be so constituted that the compaction requirements specified herein can be met. Sand is not permitted as intermediate backfill.

Intermediate backfill in public streets and highways shall be Class 2 Aggregate Base or shall otherwise conform to the requirements of the agency maintaining such streets and highways (i.e. the City, Town, County, Caltrans, etc.), but in no case will the requirements be less than those specified herein. Rounded or open graded aggregates, such as pea gravel, are not permitted for use as intermediate backfill. Use of native material for intermediate backfill within existing streets, or paved areas is not permitted. All backfill materials shall be placed and consolidated in such a manner as to permanently prevent damage to the pipeline, structure, roadbed, road surfacing and private property, or inconvenience to the public.

In the case of sewer work done under permit within new subdivisions, the installation and compaction of intermediate backfill shall be in accordance with the recommendations and specifications of the Developer's Soils Engineer, as approved by the District. If, for some reason, a soils report is not prepared which makes such recommendations and specifications, the minimum trench backfill requirements shall be those specified herein.

All intermediate backfill shall be compacted in such a manner as to obtain ninety percent (90%) relative compaction. Backfill material shall be placed in layers not exceeding eight (8) inches in loose depth and thoroughly compacted by tamping, rolling or otherwise to obtain the specified compaction.

Jetting of trenches to achieve compaction of backfill is not allowed.

The Soils Engineer hired by the Developer or, in the case of District projects, the Soils Engineer hired by the District shall take compaction tests to verify compliance with the requirements of the Agency exercising jurisdiction on the street or as required by the District.

13-06 Structure Excavation and Backfill.

- A. General - Structure excavation shall consist of the removal, to the lines designated on the plans or specified or ordered by the District, of all material of whatever nature necessary for the construction of foundations and other excavations specifically designated on the plans or in these specifications or in the Special Provisions.

Structure backfill shall consist of placing and compacting, to the lines designated on the plans or specified or ordered by the District, backfill material around structures; and other backfill specifically designated on the plans or in these specifications or in the Special Provisions.

Structure excavation and backfill shall include the furnishing of all equipment and the construction or installation of all cofferdams and other facilities which may be necessary to perform the excavations and place and compact the backfill, and the subsequent removal of such facilities except where they are required or permitted by the plans or specifications to remain in place.

- B. Excavation - All excavation for structures shall be done to the dimensions and levels indicated on the plans or specified herein. Excavation shall be made to such width outside the lines of the structure as may be required for proper working methods, the erection of forms, and the protection of the work. Care shall be taken to preserve the subgrade. If disturbed, the Contractor shall replace the disturbed subgrade with compacted, crushed rock fill or other material approved by the District in a manner which will show by test an equal bearing quality with the undisturbed subgrade.

The Contractor shall, where necessary, protect excavations from caving by shoring or similar protective measures shall be repaired by the Contractor at his own expense. All shoring shall be removed prior to the placing of concrete and/or backfill material, unless otherwise specifically authorized by the District.

The excavation shall be kept free of water while construction work is in progress and any water encountered during the process of excavation shall be controlled to the satisfaction of the District.

The Contractor shall notify the District when excavation for a structure is complete and no forms, reinforcing steel, concrete, pipe or backfill material shall be placed until the excavation has been approved by the District.

- C. Cofferdams - Cofferdams for foundation construction shall be carried below the bottom of the footings and shall be braced and as water tight as practicable. The interior dimensions of cofferdams shall be such as to provide sufficient clearance for construction forms and, when no seal is placed, to permit pumping outside the forms.

In the judgment of the Contractor, if the clearance provided on the plans between the outside of the footing and any pile or interior wall or surface is not sufficient to permit the expeditious driving of piles or building of forms, he may provide such necessary clearances by constructing the cofferdams sufficiently large to provide such clearance as he may deem necessary. It shall be considered and is agreed that any such enlargement in excess of the outside dimensions of the footing as designed is for the sole purpose of expediting the work of the Contractor and quantities of such excavation and backfill will not be included in the quantities to be paid for.

Cofferdams which are tilted or moved out of position by any cause whatsoever during the process of sinking, shall be righted or enlarged so as to provide the necessary clearance and proper location and such work shall be at the sole expense of the Contractor.

In tidal waters or in streams at a time of probable flood, cofferdams, walls shall be vented at low water elevation to insure full hydrostatic head both inside and outside of the cofferdam during the period of pouring and setting of seals.

No shoring will be permitted in cofferdams which will induce stress, shock, or vibration in the permanent structure.

When permitted by the District, cross struts or bracing may extend through foundation concrete. Such struts or bracing below low water will be permitted to remain in place. Struts or bracing above low water shall be removed and the volume displaced filled with concrete of the same mix as that specified for the surrounding concrete.

For substructure work, the Contractor shall submit drawings showing its proposed method of shoring and cofferdam construction and other details left open to his choice or not fully shown on the plans. The type and clearance of cofferdams, insofar as such details affect the character of the finished work, will be subject to the approval of the

District, but the other details of design will be left to the Contractor, who will be responsible for the successful construction of the work.

After the completion of the substructure, the cofferdams with all sheeting and bracing shall be removed by the Contractor, at his own expense, to the level of the stream bed, or groundwater table, and such removal shall be performed in such a manner as not to disturb or mar the finished concrete or masonry.

- D. Foundation Treatment - When a concrete or masonry footing is to rest upon rock, the rock shall be fully uncovered and the surface thereof shall be removed to a depth sufficient to expose sound rock. The rock shall be roughly leveled off or cut to approximate horizontal and vertical steps, and shall be roughened. The overcut of the rock shall be filled with concrete as a part of the structure, or, upon specific approval of the District, may be filled with compacted Class 2 aggregate base or crushed rock.

When piles are to be used, the Contractor, at his own expense will be permitted to excavate a sufficient distance below the bottom of the footing as shown on the plans to take care of swell due to driving piles. After the piles are driven, if it is found that the ground has risen above the planned grade, the Contractor shall remove such surplus material at his own expense. After the piles are driven, if it is found that the surface of the ground is below the planned grade, the Contractor shall backfill, at his own expense, to the planned grade with material approved by the District.

- E. Disposal of Excess Excavated Material - All materials to be removed during the course of excavation in excess of that needed for backfill, or deemed by the District as being unsuitable for backfill, shall be hauled off the job site by the Contractor and disposed of at his own expense at a legal disposal site.
- F. Inspections - In order to determine the character of the foundation material, the Contractor shall, if ordered by the District, dig test pits, and make test borings and foundation bearing tests.

Whenever any structure excavation is completed to the grade of the bottom of the footing shown on the plans, or set forth in the Special Provisions, or ordered by the District, the Contractor shall notify the District, who will make an inspection of the elevation and character of the foundation. No footing concrete or masonry shall be placed in a footing until the District has inspected and approved the elevation and character of the foundation for the footing.

- G. Backfill - Structure backfilling operations shall conform to the requirements of this section, and any requirements specified in the Special Provisions.

Structural fill material shall conform to the requirements of Section 13.04 E.

The Contractor shall make his own arrangements for obtaining structure backfill material and all costs involved therewith shall be considered as included in the contract price paid for structure excavation, or for the structure being constructed.

Structure backfill shall not be placed until the structure footings or other portions of the structure or facilities to be below ground line have been inspected by the District and approved for backfilling. No backfill material shall be deposited against the outside walls of concrete structures until seven (7) days have elapsed from the pour or until the concrete has developed the strength of 2,500 pounds per square inch in compression as determined by a break of a test cylinder cured under conditions similar to those prevailing at the site and tested in accordance with standard methods.

Backfill materials shall be placed in uniform horizontal layers not exceeding eight (8) inches in loose thickness before compaction and shall be brought up uniformly on all sides of the structure or improvement in order to avoid bending or distortional stresses. Each layer of backfill shall be conditioned for optimum moisture as necessary and thoroughly tamped, rolled or otherwise compacted or necessary to achieve a relative compaction not less than ninety percent (90%).

13-07 Embankment Construction.

- A. General - Embankment construction shall consist of the construction of fills, including the preparation of the ground areas upon which they are to rest: the construction of earth dikes for site protection; the placing and compacting of embankment material in holes, pits and other depressions within the work area.
- B. Subgrade Preparation - The relative compaction of the natural ground area upon which embankments are to be constructed, for a depth of not less than two (2) feet below finished grade, shall not be less than ninety percent (90%).

When necessary to conform to the above compaction requirements, the natural ground shall be excavated and the excavated material or other material designated by the District, backfilled in the excavated area. The backfill material shall be placed in layers not to exceed eight (8) inches in loose thickness before compaction and each layer shall be compacted as necessary to achieve a relative compaction not less than ninety percent (90%).

When embankments are to be made and compacted on hillsides, or where new fill is to be compacted against existing embankments, the slopes of the original hillside, old or new fill, shall be cut into as the work is brought up in layers. Material thus cut out shall be recompacted along with the new fill at the Contractor's expense.

- C. Embankment Materials - Wherever selection is possible, embankment material having a sand equivalent value of less than ten (10) shall be deposited in the lower portions of embankments and no such material shall be placed within two (2) feet of planned finished grade.

When the embankment material consists of large rocky material, or hard lumps such as hardpan or cemented gravel which cannot be broken readily, such material shall be well distributed throughout the embankment, and sufficient earth or other fine material shall be placed around the large material as it is deposited so as to fill the interstices and produce a dense compact embankment.

- D. Compacting - Embankments shall be constructed in compacted layers of uniform thickness and each layer shall be compacted by means of approved compacting equipment in strict accordance with the Soils Engineer's recommendation. Jetting is not permitted.

At the time of compaction, the moisture content of embankment materials shall be such that the relative compaction specified may be obtained with the compacting equipment being used. Embankment material which contains less than the required moisture content shall be watered as necessary, and the water may be added to the material at the excavation site. Compaction of embankment material which contains excessive moisture shall not be commenced until material has been allowed to dry to such an extent that the relative compactions specified may be produced with the compacting equipment being used. At all times it shall be the responsibility of the Contractor to employ such means as may be necessary to secure a uniform moisture content throughout the material being compacted. Full compensation for any additional work involved in drying embankment material to the required moisture content shall be considered as included in the contract price paid for excavating the material and/or constructing the embankment and no additional allowance will be made therefor.

Embankments shall be maintained to the grade and cross section shown on the plans until the acceptance of the contract and the Contractor shall be responsible for the stability of all constructed embankments and shall replace any portions which have become displaced or damaged.

13-08 Temporary Paving. Temporary paving shall be a minimum of two (2) inches thick and rolled with a roller after placement. The temporary paving shall be maintained by the Contractor and shall be level with adjacent pavement in a safe and usable condition until permanent paving is installed. Temporary paving shall be placed at all locations where necessary to accommodate traffic. All temporary paving materials shall comply with the requirements of the Air Quality Management District.

SECTION 14 SEWER PIPELINES

14-01 Description. Sewer pipelines shall be installed as shown on the plans and in accordance with the following provisions, the Special Provisions, and as directed by the District.

14-02 Approved Sewer Pipe Materials. The approved pipe materials for laterals and for private side sewer/lateral construction are listed in Table 1 and approved pipe materials for public sewer mains and force mains are listed in Table 2. The specific use of pipe and pipe products is subject to approval by the District. Use of pipe other than those specified hereinbelow must be reviewed by the District and specifically authorized in writing. All pipe shall be of the size, materials, and strength classifications shown on the plans or specified herein.

**TABLE 1
PRIVATE SIDE SEWER/LATERAL
(Specific Use Subject to District Approval)**

Pipe Specifications	Can Be Used for Gravity Sewers	Can Be Used for Ejector Pump Discharge Pipelines
Ductile Iron Pipe w/Rubber Ring Joints, DIP	Yes ²	No
PVC ASTM D-2241, SDR=26	Yes ¹	Yes ¹
PVC AWWA C-900, SDR=21	Yes ²	Yes ²
PVC Sch 40	Yes ¹	Yes ¹
PVC Sch 80	Yes ²	Yes ²
HDPE Pipe, min SDR=17	Yes ¹	Yes ¹

¹ Requires minimum 3-foot cover with imported bedding and pipe zone backfill.

² Requires minimum 18-inch cover on private property with imported bedding and pipe zone backfill or shaded with select native material containing rocks no larger than 1" sieve size.

TABLE 2
PUBLIC SEWER MAINS AND PUBLIC FORCE MAINS
(Specific Use Subject to District Approval)

Pipe Specifications	Can Be Used for Gravity Sewers	Can Be Used for Force Main Sewers
Ductile Iron Pipe w/Rubber Ring Joints, DIP	Yes	Yes
PVC ASTM D-2241, SDR=21	Yes	Yes
PVC AWWA C-900, SDR=18	Yes	Yes
PVC AWWA C-905, SDR=25	Yes	Yes
HDPE Pipe, Min SDR=21	Yes	Yes
Reinforced Concrete Pipe w/T-lock *	Yes	No
Pretensioned Concrete Cylinder Pipe	No	Yes

* For large diameter sewers only, i.e., 24" diameter and larger

14-03 Pipe and Joint Materials. All pipe sizes refer to inside diameter of pipe (including any pipe lining) and no pipe shall be more than one-eighth (1/8) inch smaller than its designated size.

All pipe and pipe joints between structures shall be of the same type, design, and size unless otherwise specified or permitted by the District. Care shall be exercised in the intermixing of different shipments of materials to insure well-fitted joints. All rubber gaskets and/or couplings for pipe joints shall be purchased from or through the firms supplying the pipe.

The Contractor shall submit shop and material details of all special pipe for approval of the District before the pipe shall be manufactured or used on the work, per Section 9. All pipes and fittings shall be marked with the trade or brand name of the manufacturer and inventory identification marks. All rubber gaskets shall be grease resistant.

- A. Vitrified Clay Pipe and Fittings, VCP (For Repair of Existing VCP Pipe Only) - Vitrified clay pipe and fitting shall be new, first quality pipe and shall conform to ASTM C-700, as it applies to extra strength clay pipe and fittings, unglazed, and pipe fittings shall be of a quality equal to the straight pipe.

Joints for vitrified clay pipe and fitting shall be the mechanical compression type conforming in all respects to the standards of the pipe manufacturer. Resilient material used for jointing shall conform to the specifications of ASTM C-425. Rubber couplings

used to join plain end vitrified clay pipe shall conform to the material and performance requirements of ASTM C-594 with stainless steel shear bands.

- B. Ductile Iron Pipe and Fittings, DI - Ductile iron pipe shall conform to ANSI/AWWA C151/A21.51. All ductile iron pipe shall have a seal coated cement lining of one-sixteenth (1/16) inch minimum thickness for pipe up to twelve (12) inches in diameter, and three-thirty seconds (3/32) inch up to twenty-four (24) inches in diameter, and one-eighth (1/8) inch above twenty-four (24) inches in diameter in accordance with ANSI A21.4.

All ductile iron pipe and fittings installed underground shall have bell and spigot ends, employing a single elongated rubber gasket, "Tyton" or push-on type joint, to effect the seal. Pipe and specials shall be of the diameter and class shown on the plans, or as specified. Unless otherwise noted, all ductile iron specials and fittings shall conform to ANSI C153/A21.53 specifications. Where required on the plans, joints on buried pipelines shall have an internally locking rubber ring joint. Lead joints will not be permitted unless specifically approved by the District.

All ductile iron pipe which is installed in the ground shall be provided with polyethylene encasement conforming to AWWA Specification C105-72. Polyethylene encasement shall be placed in accordance with the recommendations of the pipe manufacturer. Polyethylene envelopes shall be carefully placed and lapped, and care shall be exercised so that soil is not placed against the pipe.

Exposed piping in pump stations or other structures shall installed with flanges. All flanges shall be of the thickness specified in the American Standard for Flanged Fittings, ASA B16.1, Class 125, as adopted by the American Society of Mechanical Engineers. Flanges shall be accurately faced. They shall be at right angles with the pipe axis. All bolt holes shall straddle the vertical axis and shall be one-eighth (1/8) inch larger than the respective bolt diameters. Flanges on built-up spools shall be re-faced after mounting.

Bolts, nuts and washers shall be made of Type 316 stainless steel and shall have sound well-fitting threads. Bolts shall be provided with hexagonal chamfered heads and nuts. The underside of all bolt heads and nuts shall have true surfaces at right angles to the axis of the bolts. The lengths of the bolts shall be such that, after joints are made up, the bolts shall protrude through the nuts, but in no case shall they protrude more than 1 and one-half (1½) threads. Threads shall be lubricated with Led-plate or equal thread compound.

- C. Reinforced Concrete Pipe, RCP - Reinforced concrete pipe shall conform to ASTM C-76 and, unless otherwise indicated on the plans, in the Special Provisions or directed by the District, shall be Class IV, (2000 D) designed for a head of at least twenty five (25) feet,

and the pipe shall be centrifugally cast. D Loadings will be noted on the plans, and joint design shall conform to AWWA C-302, Section 3.3 as modified herein:

1. The joint shall be the all concrete bell and spigot type, unless otherwise specified in the Special Provisions or permitted by the District in writing.
2. The gasket shall be confined in a groove formed in the outside surface of the spigot end of the pipe.
3. The pipe shall be manufactured with Type II Cement.
4. Rubber gaskets used for jointing reinforced concrete pipe shall conform to Section 3.4 of AWWA C-302. Rubber gaskets conforming to ASTM C-361 require prior written approval of the District.
5. All RCP pipe 24” in diameter and larger shall be lined with PVC flexible sheet liner “T-Lock” lining as manufactured by Ameron.

D. Reinforced Concrete Water Pipe - Steel Cylinder Type, Pretensioned - Reinforced concrete water pipe-steel cylinder type, pretensioned, referred to pretensioned concrete cylinder pipe, shall conform to the following specifications:

1. Material, Manufacturing Operations, Testing and Inspection - All material, manufacturing operations, testing and inspection of the pipe shall be in conformance with the requirements of AWWA Standard C303, “Reinforced Concrete Water Pipe-Steel Cylinder Type, Pretensioned,” except as modified herein. The following acceptable minimums shall apply:
 - a. Wire rod reinforcement shall have a minimum spacing of 2.3 x wire rod diameter.
 - b. The cross-sectional area of the rod shall not exceed 50% of the total areas of rod and cylinder steel.

Except for specials required to meet the laying conditions, pipe will be furnished in standard lengths suiting the manufacturer's shop practice and in accordance with Section 3.1.2 of AWWA Standard C303.

2. Joint Design - The standard field joint shall be steel joint rings with rubber gaskets as per AWWA Standard C303 Sections 3.3 and 3.4. Rubber gaskets shall be grease resistant. In addition, the following pipe ends may be required as shown on the drawings.

- a. Ends for mechanically coupled field joints shall conform to Section 3.6.1 of AWWA C200.
 - b. Ends fitted with butts traps for field welded joints shall conform to Section 3.6.5. of AWWA C200.
 - c. Ends of the bell and spigot type for field welded joints shall conform to Section 3.6.2 of AWWA C200.
 - d. Plain ends fitted with flanges shall conform to AWWA C200 Section 3.6.7 and AWWA C207.
3. Restrained Joints - Where indicated on the drawings and where thrust is evident, welded joints are required. Welding of joints shall conform to the details shown in the plans.
 4. Pipe Design Criteria - Pretensioned concrete cylinder pipe shall be designed in accordance with APPENDIX A of ANSI/AWWA C303 to withstand a minimum 150 psi internal pressure and calculated soil pressures together with external AASHTO H-20 track loading.
 5. Bonding and Electrical Conductivity - All unwelded pipe joints shall be bonded for electrical conductivity in accordance with the details shown.
 6. Protection of Appurtenances - All buried flanges, valves, couplings shall be coated with a minimum thickness of one inch of cement mortar having one part cement to not more than two parts plaster sand.

All exterior surfaces which will be exposed to the atmosphere inside structures or above ground shall be thoroughly cleaned and coated according to the requirements of "Protective Coatings" Section 19.

7. Fittings and Openings - Special and standard type fittings which include bends, reducers, outlets, manholes, etc., shall be designed to a strength at least equal to the adjacent pipe and to conform to Section 4 of AWWA Standard C303 and the dimensional requirements of AWWA C208.
8. Internal Bracing and End Protection - Prior to delivery, pipe end covers and end/internal bracing shall be applied, as recommended by the manufacturer, for shipping and storage protection.
9. Shop Drawing Submittals - The manufacturer shall provide drawings in accordance with Sections 1.6 of AWWA Standard C303.

E. Polyvinyl Chloride Pipe, PVC - As designated on the plans, PVC pipe shall conform to one of the specifications below. PVC pipe with external ribbing is not allowed.

1. PVC, ASTM D-2241 (Pressure Pipe) - PVC, ASTM D-2241 pressure pipe shall conform to ASTM D-2241 with rubber ring joints and shall have a pressure rating of 160 psi unless otherwise indicated on the plans. Joints shall meet the requirements of ASTM D-3212.
2. PVC, C-900 or C-905 (Gravity Sewer and Pressure Pipe) - PVC, C-900 or C-905 gravity sewer and pressure pipe shall conform to AWWA C-900 for diameters 4" through 12" and AWWA C-905 of pipe diameters 14" thru 20" and shall have a SDR = 25, unless otherwise indicated on the plans. Joints shall be bell and spigot conforming to ASTM D-3139 with gaskets conforming to ASTM F-477.

All fittings for PVC, C-900 pipe shall either be fabricated or manufactured in one piece of injection molded PVC compound meeting ASTM C-1784. Fittings shall be Class 150 and conform to requirements of SDR = 18. Fittings shall be designed to withstand a minimum of 755 psi quick burst pressure @ 76°F tested in accordance with ASTM D-1599.

3. PVC, Schedule 40 or Schedule 80 - Schedule 40 and Schedule 80 PVC pipe and fittings shall be Type I, normal impact, rigid polyvinyl chloride conforming to the Department of commerce Commercial Standard CS 207-60, or currently applicable revisions of that standard. The pipe shall be rigid, tough, lightweight, thermoplastic pipe, UV protected, furnished in iron pipe sizes. Fittings shall be molded of the same material as the pipe. Joints shall be solvent welded or bell-and-spigot with 3/16" Neoprene or plasticized PVC gaskets.

F. HDPE Pipe - Polyethylene pipe shall be made from polyethylene resin compound qualified as Type III, Category 5, Class C, Grade P34 in ASTM D-1248-78. This material shall have a Long-Term Hydrostatic Strength of 1450 psi or 1600 psi when tested and analyzed by ASTM D-2837. Minimum thickness shall be DR=17.

The raw material shall contain carbon black, well dispersed, with a minimum of 2%. Additives which can be conclusively proven not to be detrimental to the pipe may also be used, provided the pipe produced meets the requirements of this standard.

The pipe shall contain no recycled compound except that generated in the manufacturer's own plant from resin of the same specification from the same raw material supplier.

The cell classification shall be PE 33443 - C (10 MPa) for PE 3407 materials or PE 345534C for PE 3408 materials, per ASTM D-3350/F 714-81.

Pipe sections shall be heat fused together. Only those tools specifically designed for joining polyethylene pipe and only those personnel approved by the pipe supplier and District shall join polyethylene pipe.

- G. Encasement Pipe - When designated on the plans, permit, or by the District in writing, approved encasement pipe shall be placed in a bored hole under the area to be crossed. The encasement pipe shall be plain steel and shall be of the length, diameter and thickness specified on the plans or in the Special Provisions. Plain metal pipe shall conform to the requirements of AWWA C-201 or AWWA C-202 for steel water pipe, butt welded and shall conform to the thickness given in the following table:

Protective Casings

<u>Inside Diameter</u> inches	<u>Smooth Steel Thickness</u> inches
18	1/4
21	1/4
24	1/4
30	5/16
35	5/16
48	not permitted
54	not permitted
60	not permitted

14-04 Backflow Prevention/Relief Valve. Backflow prevention/relief valve shall be Contra Costa Type or Plumbest or equivalent as approved by the District. The backflow preventer/relief valve shall be installed at an elevation at least six (6) inches lower than the lowest home fixture as approved by the District. If the backflow preventer/relief valve cannot be installed six (6) inches below the lowest fixture then a PVC check valve shall be installed in the lateral.

14-05 Flexible Couplings for Pressure Lines

- A. Flexible Couplings - Flexible couplings used for connection of sections of pipe having identical outside diameters shall be Rockwell Type 411, Dresser Style 38, or equal. Flexible couplings for connections of cast iron pipe having slightly different outside diameters shall be Rockwell Type 413, Dresser Style 162, or equal. Coupling gaskets shall be Rockwell Grade 60, Dresser Grade 42, or equal. Buried couplings shall have Type 316 stainless steel bolts, nuts and washers.
- B. Flanged Coupling Adapters - Flanged coupling adapters shall be Rockwell Type 912, Dresser Style 127, or equal, complete with Type 316 stainless steel bolts, nuts and washers. All flanged coupling adapters shall be provided with anchor studs or joint harness bolts and lugs to prevent joint separation, as approved by the District.

Restraints shall be designed for 1-½ times the maximum working pressure of the applicable service.

- C. Coatings for Flexible Couplings - All flexible couplings and flanged coupling adapters shall be fusion epoxy coated in accordance with the requirements of Paragraph 14-07 this section. Bolts, nuts and washers shall be Type 316 stainless steel. After installation, epoxy resin touch-up shall be applied to damaged coating. On underground lines, the flexible coupling and bolts shall be wrapped as specified in Paragraph 14-06.

14-06 Valves

- A. Eccentric Plug Valves - Plug valves shall be non-lubricated eccentric plug valves conforming to the following requests:
1. Type - Eccentric Plug Valves shall be of the non-lubricated eccentric type with an elastomer covering all sealing surfaces. The elastomer shall be suitable for sewage service. Flanged valves shall be manufactured in accordance with ANSI B16.1 Class 125/150, including facing, drilling and flange thickness. Ports shall be round with a minimum of 81% port area on sizes 2½” through 12” to facilitate “pigging” when required. Valves 14” and larger shall be of a rectangular port design with a minimum of 81% port area.
 2. Valve Bodies - Valve bodies shall be of ASTM A-126 Class B cast iron in accordance with AWWA C-504-87 Section 5.2.1. Valves 3” and larger shall be furnished with a welded-in overlay seat of not less than 90% nickel in accordance with AWWA C-507-85 Section 3.2.3.5. Sprayed, plated or screwed-in seats are not acceptable.
 3. Plugs - Plugs shall be of ASTM A-536 Grade 65-45-12 in compliance with AWWA C-504-87 Section 2.2.2. The plugs shall be of one piece solid construction with PTFE thrust bearings on the upper and lower bearing journals to reduce torque and prevent dirt and grit from entering the bearing and seal area.
 4. Bearings And Seals - Valves shall be furnished with replaceable sleeve type bearings conforming to AWWA C-504-87, Section 3.6.1 and AWWA C-507-85, Section 3.2.4. Bearings shall be of sintered, oil impregnated type 316 stainless steel ASTM A-743 Grade CF-8M. Valve shaft seals shall be of the “U” cup type in accordance with AWWA C-504-87, Section 3.7.2. Seals shall be self adjusting and repackable without removing the bonnet from the valve.
 5. Shutoff - Valves shall be designed and manufactured to shut off bubble tight at 175 psi for valves 2½” through 12” and at 150 psi for valves 14” through 36”. Valves 42” and larger shall be certified bubble tight at 125 psi.

6. Test - Each valve shall be given a hydrostatic and seat test with certified test results. Certified copies of Proof-of-Design test reports shall be furnished as outline in AWWA C-504-87, Section 5.2.4 when requested.
7. Manufacturer - Plug valves shall be Millcentric Series 601/600 as manufactured by Milliken Valve Company of Bethlehem, Pennsylvania.
8. Operator - Wrench operated valves 2½” – 8” shall be capable of being converted to worm gear or automated operation without removing the bonnet or plug from the valve. All wrench operated valves shall be equipped with a 2” square nut for use with removable levers or extended “T” handles.

Worm gear operators, where required, shall be of heavy duty construction with the ductile iron quadrant supported on the top and bottom by oil impregnated bronze bearings. The worm gear and shaft shall be manufactured of hardened steel and run on high efficiency roller bearings.

Provide operators for all valves. Valve rotation shall be counterclockwise (to the left) to open and the word "OPEN" and an arrow indicating the direction to open shall be cast on each valve body or operator.

Lever operators shall have a maximum pull of 80 lb. and shall be capable of withstanding a 200 lb. pull without damage. Wrench nuts shall conform to AWWA C500, Section 19 and shall be capable of withstanding a 300 ft.-lb. torque without damage. Extension stems shall be provided where indicated on drawings, specified, required for proper operation and for buried valves with operating units more than three (3) feet below grade. Stem guides shall be cast iron, bronze bushed and adjustable in two (2) directions. If extension stem length exceeds ten (10) feet or the weight exceeds twenty (20) pounds, the top guide shall be designed to carry the stem weight and provide a collar on the stem to bear against the thrust guide. The maximum spacing of non-rising stems shall be one hundred (100) times stem OD with a ten (10) foot maximum.

Buried valves shall be provided with a stem extending to within six inches (6") of grade. Provide spaces to center stem in valve box and provide wrench nut.

9. Coating - Provide shop applied coating of rust resistor primer and Tnemec Series 69 high build epoxy 12 mils thickness inside and outside.
- B. Iron Body Swing Check Valves - Check valves 2" to 12" shall be designed for working pressures of 200 pounds Cold W.O.G., non-shock and shall conform to the following Standard Specifications, latest edition:
- A.S.A. B-16.10 Section applying to 125 lb. Cast Iron Swing Check Valves.
 - A.S.A. B-16.1 Cast Iron Pipe Flanges & Flanged Fittings, Class 125.
 - A.P.I. Standard No. 6-D, for 175 lb. Pipe Line Swing Check Valves.

Hinge pins shall be stainless steel. Metal discs shall be prevented from sticking or wedging in open positions by stops. Discs shall be mounted allowing free movement of the disc to rotate assuring uniform seat wear. Check valves shall be designed with inclined seat making them suitable for use in either a horizontal or vertical position. Swing check valves 4" or larger shall be provided with external lever and spring for the balancing of the gate appropriately to operating conditions.

C. Air Release Valves

Sewage air release valves shall be equivalent in workmanship, materials, and functional characteristics to ARI Model D-020 combination air valve for sewage or Model D-025 short version.

14-07 Protective Coatings - All metal valves, fittings, couplings, bolts, and nuts buried underground shall be protected from corrosion by applying a primer Polyken 927, or Tapecoat color primer, or equal, and wrapping with polyethylene tape Polyken 930, or Tapecoat CT, or equal. Exposed metal fittings, valves, etc. in manholes or valve boxes shall be coated with two (2) coatings Tapecoat Mastic, Koppers Bitumastic No. 505, or equal. Surfaces shall be thoroughly cleaned before application. All coatings shall be applied in strict conformance with instructions of the manufacturer.

14-08 Fusion Epoxy Coating - Where required, steel pipe and fittings, valves, gates, and equipment shall be lined and/or coated with epoxy resin by the fluid bed process as specified hereinbelow.

The lining and coating material shall be a one-part, heat curable semi-flexible thermosetting light green epoxy resin powder designed for application on preheated surfaces by fluid bed process, Scotchkote 206N, as manufactured by 3M Company. Alternate coating equivalency test results shall be submitted to the satisfaction of the District at the expense of the Contractor.

Metal surface shall be prepared by blasting sand or grit to a uniform white metal appearance. All rough surface or pitted areas shall be ground smooth.

The lining and coating shall be applied within eight (8) hours of sand blasting operations. The cleaned fitting shall be preheated and maintained at the required coating temperature during the lining and coating process. Application shall be by the fluidized bed process. The finished lining and coating thickness shall be not less than 15 mils. The freshly coated fitting shall be post-heated in a suitable oven immediately following the coating application of a sufficient time to insure complete cure of the epoxy resin.

The epoxy coating and lining shall be uniform in film thickness without bare or thin spots, runs or sags, pinholes or other defects.

The epoxy application shall be proven by the following tests:

1. Adhesion Test: (a) Immersion of a 2" x 6" sample in boiling water for four (4) hours, (b) immersion of a 2" x 6" sample in 150°F water for ninety-six (96) hours. No signs of blisters, bubbles, peeling, or other forms of separation of coating shall be found.
2. Wet Sponge Holiday Detector Test. The lining shall be free of pinholes as tested by low voltage wet sponge Holiday Detector.

The application of the dry powder fusion epoxy resin shall be done only by experienced and skilled craftsmen. The manufacturer shall submit a certificate that the fitting meets, in all respects, the requirements of these specifications.

Coating damaged in the field shall be restored with a 100% solids room temperature curing epoxy resin, compatible with the fusion epoxy coating and applied in accordance with the recommendation of the manufacturer.

14-09 Conventional Pipeline Installation.

- A. Main Sewer and Trunk Sewer Pipe Laying - All pipe shall be laid to conform to the prescribed line and grade as shown on the plans. The pipe grade shall be set from the grade stakes using a laser. The grade line shall be established before any pipe is laid in the trench. Each pipe length shall be checked for conformance to the grade line.

Trench width, pipe bedding, pipe zone backfill and special laterals should conform to the plans and the Standard Drawings herein.

As the work progresses, the interior of the sewer shall be cleared of all dirt and debris of every description. Where clearing after laying is difficult because of small pipe size, a suitable swab or squeegee shall be kept in the pipe and pulled forward past each joint immediately after jointing has been completed.

Unless otherwise approved by the District, the sewer line shall be laid without break upgrade from the point of connection to existing sewer and with the bell end forward or upgrade. Pipe shall not be laid when the condition of the trench or the weather is unsuitable. When pipe laying is not in progress, the forward end of the pipe shall be kept effectively closed with an approved temporary watertight plug.

Each length of pipe shall have full bearing for its entire length and adequate bell holes shall be dug at each end of the pipe. Adjustments of pipe to line and grade shall be made by scraping away or filling in and tamping the bedding material under the body of the pipe. No wedging or blocking to support the pipe will be permitted.

Unsuitable subgrade material shall be excavated and stabilized with crushed rock to provide a firm bedding for the pipe or as recommended by the Soils Engineer.

For curved sewers, the deflection in the joint between any two successive pipe sections shall not exceed eighty percent (80%) of the maximum deflection as recommended by the pipe manufacturer. Minimum two (2) foot pipe lengths may be supplied or pipe may be cut, if approved joint material is available, to install short radius curves and to conform with the joint deflection limitations.

Sewer pipes, branches, stubs, or other open ends which are not to be immediately connected, shall be plugged or capped with a standard watertight plug or cap, as approved by the District for use in the particular installation. The plug or cap shall be placed on a standard end. Open pipe ends on which rodding inlets, flushing inlets, etc., are to be constructed shall be plugged at all times until the structure is completed and the cover in place.

All sewer line connections to manholes, trunk sewers, main sewers, or side sewers shall be left uncovered until after the inspection has been made. After approval of the connection, the trench shall be backfilled as specified.

If the sewer is to be laid in an area that is to be filled and the cover prior to filling is less than four (4) feet, the pipe shall not be laid until the area has been filled to a level of four (4) feet above the proposed pipe and compacted to ninety percent (90%) relative compaction unless otherwise authorized by the District.

The markings on reinforced concrete pipe indicating the minor axis of the elliptical reinforcement shall be placed in a vertical plane when the pipe is laid in place.

- B. Side Sewer Pipe Installation - All side sewer pipe shall be laid in conformance with the requirements set forth herein for sewer mains and trunk sewers and to the following requirements.

All side sewers shall be equipped with clean outs, backflow prevention devices, and test fittings required in the Uniform Plumbing Code, by District Ordinance, and as shown in the Standard Drawings herein.

- C. Pipe Jointing - All pipe jointing shall be accomplished by using the proper types of jointing materials as specified in Section 14-03 and in a manner conforming to the methods hereinafter specified and in accordance with the manufacturer's prescribed installation procedures.
- D. Jointing of Dissimilar Pipes - Jointing of dissimilar pipes shall be accomplished with approved special couplings or adapter. The jointings of vitrified clay and cast iron pipe may be accomplished by using an approved Fernco Coupling, Calder Coupling, Band Seal Coupling, or other special approved couplings. All couplings shall have stainless steel shear bands.

- E. Connections to Existing Sewerage Systems - It shall be the responsibility of the Contractor to determine the exact location and depth of the existing sewers prior to the installation of any sewer pipe. In the case of side sewer work, the Contractor shall also determine the elevation of the plumbing outlet at the building to be connected and decide whether the required grade and cover can be maintained between the outlet and the main sewer prior to construction of any portion of the side sewer. Where the connection is to be made in an existing manhole, the Contractor shall make the connection by carefully breaking through the manhole wall, cutting the floor or concrete base, installing the pipe through the wall with minimum 1-1/2" and maximum 2" protrusion, and forming a new channel, and repairing and damage to the structure. The floor and channel of the manhole shall be finished with a smooth finish. Where the connection is to be made by constructing a new manhole on an existing sewer, the connection and manhole shall conform to the details shown on the Standard Drawings.
1. Main Sewers - Connection of main sewers and trunk sewers shall only be made in manholes, or special structures.
 2. Side Sewers - Where wyes, tees and/or laterals were previously installed on the main sewer, the side sewer or building sewer shall be connected to the wye, tee, or lateral as provided for the particular connection. Where a wye, tee, or lateral has not been installed at the point of desired connection, either a standard wye or tee fitting shall be "cut-in" to the main sewer using approved couplings and fittings of the same material as the main sewer, or the connection shall be made using the slope of the last twenty (20) feet of a side sewer connecting to a sewer main. This slope shall be less than 30E from the horizontal. A "Tap Tite", "Inserta Tee" or equal method may be used. Inserta Tee may only be used on sewer mains 12" in diameter or larger.
- F. Special Jointing Requirements in Filled Ground - Where construction takes place in filled marsh land or areas underlain by bay mud, or any other areas which in the judgment of the District are subject to possible subsidence or differential settlement, special pipe jointing will be required for pipe entering and leaving manholes or structures. When indicated on the plans or in the Special Provisions or directed by the District, all sewer lines smaller than twelve (12) inches entering and leaving manholes or structures shall have two (2) approved flexible joints within four (4) feet of the manhole base or structure, with not less than twelve (12) inches between joints. All sewer lines twelve (12) through eighteen (18) inches shall have one (1) approved flexible joint within twelve (12) inches of the manhole base or structure.
- G. Force Main (Pressure Sewer) Pipe Installation - Force main pipe shall be laid in conformance with the requirements set forth herein for main and trunk sewer pipe, and to the following requirements.

Unless joints are otherwise restrained concrete thrust blocks shall be provided on all force main bends having a deflection angle of eleven (11) degrees or more, and at elbows, tees and valves. Thrust blocks shall have a sufficient bearing area to withstand the maximum force to be exerted. For cement lined and coated steel pipe, pipe joints may be welded one hundred (100) feet either side of the bend in lieu of providing a concrete thrust block.

Unless otherwise specified on the plans, in the Special Provisions or directed by the District, all valves to be installed in force mains shall be plug valves as specified in Section 14-05A. Unless otherwise shown on the plans each valve shall correspond to the size of the run of pipe on which it is to be installed.

Force main valves shall be installed in accordance with Standard Drawing No. SD 14. The cover shall be marked with the word "sewer." An extension stem, valve wrench and all materials and equipment necessary for easy and proper valve operation shall be supplied. Proper clearance shall be provided between the riser and the cover of the box so that traffic loads will not be transferred to the valve or pipe.

14-10 Trenchless Sewer Installation - When shown on the Plans and as specified in the Special Provisions, sewer pipe may be installed by trenchless methods as specified herein below:

A. Boring and Tunneling - Where an encasement pipe is bored or jacked under a street, highway, or railroad, the pipe and construction methods shall conform to the requirements of the agency with jurisdiction over the street, highway or railroad.

1. Bores - Where an encasement pipe or sewer pipe is installed in a bored hole, whether wet or dry, the hole shall be bored by use of a machine which will cut a true circular bore to the required line and grade. Bored tunnels shall be no more than two (2) inches larger in diameter than the maximum outside diameter of the encasement pipe or sewer pipe to be placed therein. Main or side sewer pipes installed in bores without encasement pipes shall be ductile iron, Class 50, unless otherwise specified in the Special Provisions or directed by the District.

After the main and side sewer pipe is secured in place, the space around the pipe shall be completely filled with sand or grout as directed by the District.

2. Tunnels - Where tunnels without encasement pipes are required or permitted, they may only be drilled with approved equipment which will cut a true circle on grade to a diameter not greater than two (2) inches larger than the greatest diameter of the sewer pipe, or they may be excavated by standard tunnel methods using shoring, lagging and adequate support, where necessary.

3. Installation - The encasement pipe shall be installed by jacking or tunneling in such a manner as not to interfere with the utility, railroad track, street or highway being crossed. Sufficient jacking capacity shall be provided in advance to insure successful completion of the operation. Guide rails shall be accurately set to the

line and grade so that the pipe, while being jacked, will be guided along the prescribed line and grade. A rigid backstop shall be erected to withstand the full thrust of the jacks during the process of installing the pipe. Jacks and bearing frame with necessary blocking shall be provided of sufficient strength and number to propel the pipe forward as excavation progresses ahead of the forward end of the pipe.

If a void develops between the encasement pipe and the surrounding soil, the void shall be completely filled with grout as directed by the District or as directed by the agency with jurisdiction over the street, highway or railroad.

4. Blocking Carrier Pipe - After the casing has been installed, two (2) redwood skids of appropriate cross-sectional dimensions, running the full length of each pipe section, shall be strapped securely to each section of sewer pipe and each section shall then be pushed or pulled into the encasement pipe after jointing. The skids shall be tapered as necessary to assure proper sewer grade. Extra care shall be taken to insure proper pipe jointing since a misplaced rubber joint ring would be extremely difficult to correct once the pipe has entered the casing. Appropriately sized redwood blocks shall also be secured at suitable intervals to each piece of sewer pipe to prevent the possibility of the pipe floating within the casing. Exact details of installation, including all redwood skid and block sizing and spacing shall be submitted by the Contractor for specific approval of the District well in advance of starting this work.
 5. Filling Annular Space - After the pipeline has been cleaned and tested in accordance with Section 14-10, the space between the pipe and the casing, at both ends of the casing, shall be plugged with brick and mortar in accordance with accepted construction practices. Unless otherwise indicated on the plans or in the Special Provisions, the space between the sewer pipe and encasement pipe shall be filled with sand or grout, as shown on the Plans or as directed by the District.
- B. Pipe Bursting - Trenchless sewer installation by pipe bursting involves the shattering of an existing sewer and pushing the broken pieces into the surrounding soil and then inserting a polyethylene pipe liner.
1. Methods Pipe bursting methods may include a hydraulic expanding head or a conical head pulled through the sewer to be burst with sufficient force to break the existing sewer and insert the new liner pipe. Use of a pneumatic percussive head is not allowed unless specifically permitted by the District.

The Contractor shall be certified by the Pipe Bursting System Manufacturer that such firm is a licensed installer of their system. Polyethylene pipe jointing shall be performed by personnel trained in the use of joint fusion and stab joint equipment and recommended methods for pipe liner connections.

2. Preparation Prior to commencing the pipe bursting procedure, the Contractor shall televise the existing sewer to determine the location of each house laterals and to determine if there are any obstructions or special problems in the sewer to be pipe burst.

Each lateral shall be exposed and the Contractor shall verify that each one is live prior to pipe bursting. The Contractor shall also determine whether or not extra laterals which are found during the televising are live or dead, since some houses may have more than one lateral.

3. Access Excavations - The Contractor shall construct access excavations as necessary for the pipe bursting and liner insertion. When practicable, access excavations shall be located where interference to vehicular traffic and inconvenience to the public is minimized. Excavations for pulling or pushing equipment shall have adequate support provided to prevent damage to adjacent areas.

Existing manholes shall be excavated for access excavations wherever practical. Manhole inverts and bottoms shall be removed to permit access for installation equipment.

4. Bypassing Sewage During pipe bursting of a live sewer, the Contractor shall bypass the sewage around the section or sections of sewer line to be rehabilitated. The bypass shall be made by plugging existing upstream manhole and pumping the sewage into a downstream manhole or adjacent system or other method as may be approved by the District. The pump and bypass lines shall be of adequate capacity and size to handle the flow without backing up the sewage to a point that threatens connected homes.

The Contractor shall be responsible for continuity of sanitary sewer service to each facility connected to the section of sewer during the execution of the work. If it is necessary to continue the bypass during non-working hours, the Contractor shall provide a high water alarm.

Support equipment used to perform the work shall be located away from buildings so as not to create a noise impact. Provide silencers or other devices to reduce machine noise as required to meet applicable noise ordinances.

5. Pipe Installation Thread the necessary lines through sewer section to be rehabilitated and then pull the bursting head followed by the liner pipe.

After the pipe has been installed in the entire length of the sewer section, the liner pipe shall be anchored at manholes. The pipe shall protrude in the manholes for enough distance to allow sealing and trimming. Sealing the pipe at manholes

providing a flexible gasket connector shall be installed in the manhole wall at the end of the pipe, centered in the existing manhole wall. Grout the flexible connector in the manhole wall filling all voids the full thickness of the manhole wall. Restore manhole bottom and invert.

6. Sewer House Connections Sewer house connections shall be connected to the liner pipe by heat fusion saddles. Once the saddle is secured in place, drill hole full inside diameter of saddle outlet in pipe.

The existing house sewer shall be connected to the saddle using a flexible coupling. After connection to the saddle, the side sewer connection pipe shall have a slope toward the newly lined sewer equal to the slope of the existing lateral pipe or a minimum of two percent.

C. Directional Drilling Procedure

1. General Horizontal directional drilling shall consist of the drilling of a small diameter pilot bore from the entrance pit to the exit pit. Once the pilot boring is in place and conforms to the horizontal and vertical design requirements shown on the plans and specified below, the Contractor shall ream out the hole to the smallest practicable diameter and then use “pipebursting” head to pull the pipeline into place.
2. Guidance Of Pilot Bore The Contractor shall prepare and submit a bore plan which includes drilling machine, bore hole location technique to be used, final bore hole diameter and final bore hole grouting methods if required, to the District for review prior to commencing work. Pipelines installed by directional drilling must be located horizontally and vertically to the design grade in the location as shown on the plans and no shallower than the vertical design location as shown on the profile or as specified herein. The head of the pilot bore shall be equipped with a sewer grade transmitter which will allow the Contractor to determine its location, pitch in 0.1 percent increments from 0.1 to 45 percent, roll, battery status and depth from the ground surface. Based on this information, the Contractor shall determine the pilot location and plot on the plans the actual horizontal, vertical alignment and sewer grade of the pilot boring at intervals not exceeding every ten (10) feet during the drilling of the pilot boring. The current plot shall be available for inspection upon request by the inspector. The alignment and depth of the pilot boring must be approved by the District before the pipeline is pulled.
3. Drilling Operation Upon request by the inspector the Contractor must demonstrate the accuracy of the transmitter installed within the bore tool housing prior to pilot boring operations commencing. Use of bent drill rods is not acceptable and shall be replaced with a straight rod at the request of the inspector.

During the drilling operation, the Contractor shall make adequate provision to contain and dispose of muddy water or drilling mud. Muddy water or drilling mud must not be discharged to any storm drains, creeks, or watercourses. Where no provisions can be made for storage of muddy water or drilling mud on-site, it must be hauled away to a suitable legal disposal site on a daily basis.

4. Bore Hole Any over bore between the pipe and the actual bored hole shall be sealed for its entire length with cement slurry grout, taking care not to collapse, overheat, or otherwise damage the pipe.

14-11 Cleaning and Testing - Gravity Mains and Trunk Sewers. After installation, all gravity and trunk sewers shall be tested and cleaned as herein specified, in the presence of the District inspector. The Contractor shall notify the District Inspector twenty-four (24) hours prior to any testing during normal working hours. The program for testing and cleaning shall fit the conditions as mutually determined by the District and the Contractor. The Contract shall furnish all labor, tools, equipment and water necessary to make all tests, clean the lines and to perform any work incidental thereto. The Contractor shall take all necessary precautions to prevent any joints from pulling while the pipelines or their appurtenances are being tested. He shall, at his own expense, correct any excess leakage and repair any damage to the pipe and its appurtenances or to any structures, resulting from or caused by these tests. Materials and methods used for any necessary repair work shall be specifically approved by the District.

The Contractor shall flush all sewer lines prior to testing and accumulated materials shall be removed at each manhole and no materials shall be allowed to enter the existing sewer system. A plug shall be installed and maintained by the Contractor in the line connecting to the existing system until all cleaning and testing is completed and the lines are approved for operation. All side sewers shall be plugged at their ends until hooked up to the building sewer.

- A. Testing - Each section of sewer line shall be tested as provided herein using either water or air at the option of the Contractor. However, in the event that the Contractor elects to test sewer sections using the air test method, each manhole shall be tested separately using the procedure outlined in Section 16-08.

The infiltration test described below may be required by the District in addition to either the water or air tests.

All testing specified herein below shall be done after the placing and compaction of intermediate trench backfill and placement of the road subbase, but prior to final paving. If a new street is being constructed involving the placement of cement treated or lime treated base, the testing and repair of all sewers shall be completed prior to installation of such base.

1. Water Test - Each section of sewer shall be tested between successive manholes by plugging the lower end of the sewer to be tested and the inlet sewer of the upper

manhole and filling the pipe and manhole with water to a point four (4) feet above the crown of the sewer in the upper manhole, or, if ground water is present, four (4) feet above the average adjacent ground water level. For the convenience of the Contractor, where grades are slight, two (2) or more sections between manholes may be tested at once. However, when testing more than one section, the allowable leakage for the total length shall be that computed for the shortest section of pipeline between manholes tested. Where grades are steep and excessive test heads would result by testing from one manhole to another, test fittings the full size of the main shall be installed at intermediate points so the maximum head on any section under test will not exceed twelve (12) feet. The lines shall be filled at least two (2) hours prior to testing and shall be tested at least one (1) hour maintaining the head specified above by measured additions of water. The sum of these additions shall be the leakage for the test period.

The allowable leakage shall be figured as fifty (50) gallons per day per inch of sewer diameter per mile of main sewer being tested. After that time the leakage shall be measured and, if any leakage exists, the Contractor shall discover the cause and remedy it before the sewer is accepted. Where the actual leakage is less than the allowable and leaks are observed, such leaks shall be repaired at the Contractor's expense, as directed by the District.

2. Air Test - Low pressure air tests for sewers between structures shall be accomplished by carefully placing test plugs at each end of the section of line to be tested. Air test shall be allowed on lines only up to 10" in diameter. When all necessary test equipment is in place, a compressed air supply shall be attached to the air fitting on the equipment and the air pressure within the line increased to the test pressure. After the air supply is securely turned off or disconnected, there shall be a two (2) minute waiting period to allow stabilization of air within the sewer line before the actual test period begins. The test pressure shall be at least five (5) pounds per square inch at the beginning of the test.

The air pressure must not drop over a ten (10) minute period.

The maximum length of a sewer line that may be tested at one time shall be five hundred (500) feet, exclusive of any laterals. After completion of a test, the air pressure shall be released slowly through the valve, which is incorporated in the test equipment. Air test plugs shall not be removed until the air pressure is no longer measurable.

If groundwater is known to be present, the beginning test pressure shall be increased as directed by the District.

When the Contractor elects to test sewer sections using the air test method, each manhole shall be water tested by plugging all inlet and outlet pipes and filling the manhole with water, per Section 16-08.

- 3. Infiltration Test - If in the construction of a sewer, excessive ground water is encountered, the tests for leakage described above may, at the discretion of the District, be supplemented by the infiltration test described herein. Test sections shall be isolated and any pumping of groundwater shall be discontinued for at least three (3) days and the groundwater shall be allowed to rise to maximum level. The infiltration rate shall then be measured at the low end of the test section.

The infiltration rate shall not exceed fifty (50) gallons per day per inch of sewer diameter per mile of main sewer being tested. No additional allowance shall be made for manholes or other structures. If the observed infiltration rate exceeds the allowed limit, the required repairs shall be made and the section shall be retested. Repairs and retesting shall be repeated until the observed infiltration falls within the allowed limit. Notwithstanding satisfactory passing of other than leakage tests or infiltration tests, where infiltration is later discovered in excess of the allowed limit before completion and acceptance of the sewer, the sewer shall be immediately uncovered where necessary and repairs made to reduce the infiltration rate within the allowed limit before the sewer is accepted. However, should 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.

- B. Cleaning - After gravity main and trunk sewers have been tested for leakage and after either temporary or permanent surfacing replacement has been installed, but prior to acceptance, they shall be tested for obstructions and cleaned by hydro-flushing with high pressure water using hydrovac equipment or balling with a Wayne ball. The District reserves the right to ask the Contractor to clean downstream sewer lines if, in the opinion of the District, there is reason to believe dirt and debris may have entered the District's system.
- C. Deflection Test - After the sewer main has been tested hydrostatically or with air and cleaned, but before sewage is allowed to enter it, the Contractor shall conduct a test for excessive deflection of all PVC sewer mains except PVC C-900 pipe. The deflection test shall consist of pulling a mandrel of a predetermined diameter through the pipeline. The mandrel shall be based on a five (5) percent allowable deflection and six (6) percent go-no-go. Mandrels shall have the following outside diameter.

Sewer Diameter Inches	Mandrel Outside Diameter Inches
6	5.54
8	7.42
10	9.27
12	11.03
15	13.51

If the sewer pipe does not meet the mandrel test, it shall be removed and relaid.

- D. Television Inspection – After the sewers have been backfilled, completed, tested and cleaned, but before acceptance of the job, the Contractor shall arrange and pay for closed circuit television inspection of the sewer mains and each lateral. All televising shall be performed by a firm experienced in closed circuit televising of sewer lines acceptable to the District. Televising shall be in color and done in the presence of the District Inspector, and the Contractor shall furnish to the District a videotape and DVD (sewer main only) of the complete television inspection. The television camera shall be equipped with a measuring device so that the depth of any sags can be accurately determined. The television camera shall be equipped with an articulating camera head which would allow the camera to inspect the lateral stub connection and pipe joints. Defects, including but not limited to sags, leaks, breaks, excessive pipe deflection, etc., which are in excess of the limits specified above, revealed by the television inspection shall be promptly corrected by the Contractor at no expense to the District. Television inspection will be paid for on a lineal foot basis in accordance with the bid item therefor.

The grade of all gravity sewers shall be within " 0.05 feet of the elevations and grades shown on the plans with the provision that, in no event, shall a gravity sewer, drain, or air vent line be allowed to have a sag or standing water greater than 0.10 feet deep.

Defects, including but not limited to sags that are in excess of the limits specified above, leaks, breaks, excessive pipe deflection, etc., as revealed by the television inspection shall be promptly corrected by the Contractor at no expense to the District.

After correction of the defect or defects found by the television inspection, the pipeline where the corrections were made shall be retelevised at the Contractor's expense. The retelevising shall be performed by a firm experienced in closed circuit televising of sewer lines acceptable to the District.

- E. Warranty Inspection – All sewer mains shall be retelevised eleven (11) months after acceptance by the District as a warranty inspection. Any and all defects revealed by this retelevising shall be corrected.

14-12 Side Sewer Testing -All side sewers shall be tested and cleaned in the same manner as that specified for main sewers, in the presence of the District Inspector. An approved test fitting and plug shall be installed at or near the point of connection to the main sewer, or lateral sewer if existing, and at the connection with the building plumbing. The pipe shall be tested after it has been bedded and shaded. Any leaks discovered shall be repaired by the Contractor at his expense.

Test fittings shall be wye branches or tees of the same type, size and quality as that of the side sewer, unless otherwise approved, and shall be installed where required. The branch of each test fitting shall be laid in an upright position. After the test is completed and the test plug has been removed, the test wye shall be capped or completed per Standard Drawing SD 6.

14-13 Testing of Force Mains - All force main pipes shall be thoroughly cleaned by flushing prior to testing in such a manner that no materials are allowed to enter the existing sewer system.

After installing the force main pipe and after placing and compacting the intermediate trench backfill and placement of road subbase, but before final paving has been placed and compacted as specified herein, all force mains shall be tested for leakage as provided below. The program for testing shall fit the conditions as mutually determined by the District and the Contractor. The Contractor shall furnish all labor, tools, equipment and water necessary to make the tests and to perform any work incidental thereto. Any leaks which may develop shall be repaired by and at the expense of the Contractor, and he shall, at his own expense, correct and repair any damage to the pipe and its appurtenances, or to any other structures, resulting from or caused by the tests.

A hydrostatic test shall be applied for not less than two (2) hours, or for as long as may be necessary to check all joints and find any leaks which might develop. The test pressure should be 120% of the total dynamic head of the system or fifty (50) pounds per square inch, whichever is greater. Force main pipe installations will not be accepted unless there is zero leakage. Use of air to test force mains is not permitted.

SECTION 15 DEMOLITION AND ABANDONMENT OF LINES AND STRUCTURES

15-01 Description. The Contractor shall remove equipment and concrete work as necessary for the construction of work and abandon certain pipelines and structures as shown on the plans and as specified.

15-02 Safety. The Contractor shall take all necessary precautions with regard to safety in carrying out the demolition work. Suitable barriers shall be erected around the demolition area to protect workmen and the public, and the Contractor shall rigorously comply with applicable safety requirements.

15-03 Salvage of Equipment and Materials. All electrical and mechanical equipment and piping designated to be salvaged shall be carefully salvaged and delivered to the District in good condition. When designated on the Plans or in the Special Provisions, the Contractor shall give the District two (2) working days to remove sensitive electrical equipment. Salvaged materials shall not be reused in new work unless specifically permitted by the District.

15-04 Methods and Equipment. Before starting work, the Contractor shall inform the District fully as to the method of demolition he proposes to follow, and the amount and character of equipment he proposes to use, which shall be subject to the approval of the District. The approval of the District shall not be considered as relieving the Contractor of the responsibility for the safety of his method or equipment or from carrying out the work in full accordance with the plans and specifications.

15-05 Removal of Old Structures. The Contractor shall carefully dismantle old structures which, unless otherwise provided in the Special Provisions.

15-06 Abandonment of Pipelines. Pipelines to be abandoned shall be filled with grout and securely closed at all pipe openings by a watertight plug of concrete, or brick and cement mortar, not less than three (3) feet thick.

The grout materials for filling pipelines shall consist of Portland cement, or Portland cement and fly ash with additives to enhance maximum flowability without bleeding or segregating.

1. The grout shall have a minimum compressive strength of 25 psi in 24 hours when tested in accordance with ASTM C-403 and a minimum compressive strength of 100 psi in 28 days and maximum compressive strength of 150 psi in 28 days when tested in accordance with ASTM C-495 or C109.
2. The Contractor shall establish the proposed grout mixes, methods, plans and criteria that the grouting operations shall meet. The grouting system shall have sufficient gauges, monitoring devices and test to determine the effectiveness of the grouting operation and to ensure complete fill (100%) and that no voids exist within the pipeline or structure.

3. One or more mixes shall be developed to completely fill the abandoned pipe/structure and to meet the following requirements:
 - a. Accommodate the diameter or size of pipe/structure
 - b. Accommodate the void size of the surrounding soil
 - c. Accommodate the absence or presence of ground water
 - d. Provide the acceptable strength and durability
 - e. Provide load bearing capacity
 - f. Shrinkage shall not exceed 2% by volume

4. The Contractor shall design a grout mix with a maximum density of 65 PCF, while at the same time maintaining apparent viscosity not to exceed 18 seconds as tested in accordance with ASTM C939. The ultimate load bearing capacity shall be 36 tons/SF minimum.

15-07 Sewer Structures to be Abandoned. Sewer structures to be abandoned shall have all openings, sewer lines, inlets and outlets sealed off, and the structure shall be removed to a point three (3) feet below the proposed street grade or ground surface and filled with intermediate backfill material compacted to 90% relative compaction.

The surface shall be restored as shown on the typical trench section shown on the plans. Where manholes to be abandoned are in landscaped areas, an approved top soil mix shall be placed in the top 12” and the landscaping shall be restored.

The manhole frame and cover from existing manholes to be removed or abandoned shall not be re-used on new manholes and shall become the property of the Contractor.

Manholes Manholes designated to be removed shall be excavated, all castings, covers, barrel sections and the base shall be completely removed and disposed of at a legal disposal site. The excavation shall be backfilled with intermediate backfill material and compacted as necessary for the final surfacing.

15-09 Disposal of Materials and Debris. All materials and debris resulting from the demolition work and after salvage by the District shall become the sole property of the Contractor and shall be disposed of by the Contractor at a legal disposal site.

SECTION 16 MANHOLES

16-01 Description. Manholes shall be installed at location shown on the plans and in accordance with the following provisions, the Special Provisions and the Standard Drawings.

16-02 Precast Manholes. All precast manhole sections shall conform to ASTM C-478, except that Type II modified Portland cement shall be used. The design, the specifications and the name of the manufacturer of any precast manhole units shall be submitted to the District for approval prior to purchase. All precast manhole sections shall be vacuum tested at the factory prior to shipment and shall bear a stamp that the precast manhole section has passed the vacuum testing requirements specified in Section 16-07.

16-03 Manhole Channels. Where sewer lines pass through manholes, construction shall conform to the applicable Standard Drawings. Pipe shall be used as a form for the channel if the proper positions of the flexible joints can be maintained. Whether pipe or channel forms are used, after the manhole base concrete has taken a set, the channel shall be checked with the proper template. All channels shall be finished smooth with a steel trowel.

16-04 Precast Manhole Construction. An approved form ring conforming to the dimensions of the precast barrel section joint shall be used to form a joint groove in the manhole base prior to setting the first barrel section. The concrete base shall be sufficiently cured to the satisfaction of the District before the first barrel section is set. All joint surfaces of precast sections and the manhole base shall be thoroughly clean prior to setting precast sections. These various sections shall be set in a Ram-Nek sealing gasket, or equal, and installed in accordance with the manufacturer's recommendations.

Handling of barrel sections after the sealing gasket has been affixed shall be carefully controlled to avoid bumping the gasket and thus displacing it or covering it with dirt or other foreign materials. Any gaskets so disturbed shall be removed and replaced if damaged and repositioned if displaced. Care shall be taken to properly align the manhole section with the previously set section before it is lowered into position.

Use of precast manhole bases is not permitted.

16-05 Adjusting or Repairing Manholes. All workmanship and materials shall conform to these Standard Specifications and to the Standard Drawings of the District. In the case of existing brick or cast-in-place concrete manholes, repair or adjustment in kind or with precast elements may be permitted upon approval of the District. Standard undamaged frames and covers shall be reinstalled unless otherwise directed by the District. Where the completed manhole throat will exceed twelve (12) inches, adjustment shall be made by removing the upper portion of the manhole down to the first barrel section. Precast concrete barrel and cone sections shall be used to reconstruct the upper portion of the manhole in accordance with the

Standard Drawings. The frame and cover shall be set to conform to the requirements of the individual location.

Before any work is started on adjusting or repairing a manhole, the channel inside the manhole base shall be covered with a temporary debris cover, consisting of plywood and canvas. This temporary debris cover shall be kept in place during all work, and upon completion, the canvas and the plywood shall be carefully removed from the manhole interior allowing no debris to fall or to remain in the manhole.

16-06 Temporary Covers and Plugs for Structures. The District must have accessibility to manholes to allow maintenance of the system at all times. In streets, avenues, intersections, lanes, any public thoroughfares involving automobile traffic, buses, trucks, etc., the permanent manhole casting and cover shall be installed on all actively used sewers and sewer mains, including manholes, where live laterals and/or the main sewer is being used. The permanent manhole, casting and cover shall be brought to the grade of the temporary asphalt. The manhole, frame and cover shall at a later date be set to grade to match the permanent grade when the final paving is being done.

Temporary steel plate covers of approved design shall only be used on inactive sewer lines during the construction in subdivisions or other areas not subject to active vehicular traffic where final grades for unfinished roadbeds have not been determined, or where approved or ordered by the District. If the sewer being constructed is actively used, the Contractor shall install the permanent manhole frame and cover so the District can have access to the sewer for maintenance.

A temporary debris cover, as described in Section 16-05, shall be placed over the base of any existing manhole prior to beginning any adjustment or repair work.

16-07 Manhole Testing. All manholes shall be watertight. All manholes shall be successfully tested either with clean water or by vacuum testing.

A. Water Testing Of Manholes. When a manhole is to be water tested the inlet and outlet sewers shall be plugged and the water shall be brought up above the cone section so that the water level is at least three (3) feet above the level of groundwater outside the manhole. Manholes shall be watertight with zero (0) leakage of water as tested over a fifteen (15) minute period. The Contractor shall repair any and all leaks into the manhole noted during conditions of high groundwater.

B. Vacuum Testing Of Manholes

1. Sanitary sewer manholes may be vacuum tested in lieu of water testing. Vacuum testing of manholes shall be performed twice, first prior to backfilling and then again after backfilling.

2. Vacuum testing of manholes shall conform to the standard set for in ASTM C1244-93 Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test.
3. The District representative shall be notified a minimum of two working days prior to the testing of the manholes.
4. The Contractor shall be responsible to perform the tests. The District's representative shall be present during all tests.
5. The Contractor shall document the tests and submit this documentation to the District.
6. Manholes shall be prepared for vacuum testing as follows:
 - a. All lift holes shall be plugged.
 - b. All pipes entering the manhole shall be temporarily plugged, taking care to securely brace the pipes and plugs to prevent them from being drawn into the manhole.
7. Vacuum testing of manholes shall be conducted as follows:
 - a. The test head shall be placed at the top of the manhole in accordance with the manufacturer's recommendations.
 - b. A vacuum of 10 inches of mercury shall be drawn on the manhole, the valve on the vacuum line of the test head closed, and the vacuum pump shut off. The time shall be measured for the vacuum to drop to 9 inches of mercury.
 - c. The manhole shall pass if the time for the vacuum readings to drop from 10 inches of mercury to 9 inches of mercury meets or exceeds the values indicted in Table 1.
 - d. If the manhole fails the initial test the leaks shall be located and the necessary repairs made by an approved method. The manhole shall then be retested until a satisfactory test is obtained.
8. If the vacuum test fails, or 10" Hg vacuum cannot be obtained the following procedure shall be followed to locate the leaks.
 - Shut off vacuum pump
 - Remove vacuum test plate from manhole
 - Then, using a 2 gallon hand pump sprayer (like a garden sprayer), spray the interior surface of the manhole with a soap and water mixture

- Begin testing
- After 30 second, stop vacuum and remove vacuum test plate once again
- Check the inside of manhole for soapy bubbles, indicating the areas that leak

TABLE 1 - VACUUM TEST TIMETABLE

MANHOLE DEPTH-FEET	MANHOLE DIAMETER-INCHES		
	48"	60"	72"
4'	10 sec.	13 sec.	16 sec.
8'	20 sec.	26 sec.	32 sec.
12'	30 sec.	39 sec.	48 sec.
16'	40 sec.	52 sec.	64 sec.
20'	50 sec.	65 sec.	80 sec.
24'	60 sec.	78 sec.	96 sec.
*	5.0 sec.	6.5 sec.	8.0 sec.

*Add "T" times for each additional 2' depth.

(The values listed above have been extrapolated from ASTM designation C924-85.)

SECTION 17 STRUCTURAL CONCRETE

17-01 Description. Structural concrete shall include the furnishing all labor, tools, equipment and material necessary for the installation of all concrete, reinforced concrete, reinforcing steel, grout, and mortar, as detailed on the plans or in the Special Provisions.

Concrete work shall also include the treatment of concrete surfaces; the provision of construction joints; the placing and setting of all anchor bolts, pipe railings, manhole steps and floor opening frames and covers, and all appurtenances to the mechanical, and electrical equipment that must be attached to or set into the concrete; the setting of all anchor bolts for structural steel, and all miscellaneous items attaching to the concrete as detailed on the plans or in the Special Provisions under the equipment section of the work.

17-02 Standards. All concrete materials and construction shall comply with the requirements, and be in accordance with the American Concrete Institute Standard 301, "Specifications for Structural Concrete for Buildings," except as supplemented and modified as follows (all references to "Architect/Engineer" in the ACI Standard shall be interpreted as referring to the District). Design and construction shall conform to the latest "Uniform Building Code." Arrangement and details of reinforcing steel, including bar supports and spacers, shall be in accordance with the latest ACI 315 detailing manual.

17-03 Strength. All concrete shall be Working Stress type concrete for use in structures or structural elements which have been analyzed and proportioned by working stress (straight line) theory.

The concrete for all structures shall have a minimum compressive strength of three thousand five hundred (3,500) pounds per square inch twenty-eight (28) days after placement.

All structural concrete shall be Class A containing a minimum of five hundred sixty-four pounds (six sacks) of Portland cement per cubic yard.

17-04 Submittals. The Contractor shall submit to the District for favorable review the following, even though items proposed to be furnished conform to the exact description stated in the specifications or as shown on the plans:

1. A notarized statement stating that the cement conforms to ASTM C-150.
2. Concrete mix design and strength data.
3. Shop Drawings of reinforcing detail and layout.

17-05 Cement. All cement for all structures shall be Type II, ASTM C-150.

17-06 Admixtures. Admixtures may be used subject to District approval.

17-07 Aggregates. All aggregates shall conform to "Specifications for Concrete Aggregates" (ASTM C-33). All aggregates shall have a minimum C.V. (cleanliness value) and S.E. (sand equivalent) of not less than 75. Three (3) samples shall be tested in each case and shall be taken from the weight hopper. The average of the results of the individual tests will be the accepted value in each case. These values shall be maintained throughout the course of the work, and any indicated deviation therefrom will be cause for rejection of such material, pending additional tests. Tests shall conform to Test Method No. Calif. 227 for cleanliness value and Test Method No. Calif. 217 for sand equivalent (Materials Manual, Testing and Control Procedures - Materials and Research Department, State of California).

The nominal maximum size of aggregates shall be 1½"; gradation shall be based on a 1½" nominal maximum size aggregate. In thin section (6" or less in thickness), a ¾" nominal maximum size aggregate may be used if expressly approved in writing by the District.

17-08 Selection of Proportions. The Contractor shall have his mix designed and shall submit the proposed proportions to the District for review and approval. The cement content shall be not less than six (6) sacks of cement (94 lbs. per sack) per cubic yard of concrete, and the water-cement ratio shall not be greater than 5.75 gallons of water per sack of cement. Only clean, fresh water shall be used for making concrete.

17-09 Reinforcing Steel. Unless otherwise specified, reinforcing steel shall be Deformed and Plain Billet-Steel Bars for Concrete Reinforcement conforming to ASTM A-615 Grade 60. Bars smaller than #4 bars shall be ASTM A-615 Grade 40. Reinforcing bars shall be placed in accordance with the size and spacing shown on the plans.

Mesh reinforcement shall conform to the requirements of ASTM A-185. The gauge of the wire and the dimensions of the mesh shall be as detailed on the plans or in the Special Provisions.

17-10 Formwork. Lumber and plywood shall conform to the dimensions of the concrete surfaces shown on the plans, shall be sufficiently tight to prevent leakage, and shall be sufficiently strong and braced to maintain their proper shape and alignment.

All sharp edges and corners shall be chamfered with one (1) inch triangular fillets, unless otherwise directed by the District. The triangular fillets or chamfer strips shall be milled or surfaced on all sides. Curved surfaces shall be formed of strips of matched lumber not over four (4) inches wide or of other material, such as plywood or metal, which has been approved by the District.

Unless specifically approved by the District, earth cuts shall not be used as forms for vertical surfaces other than foundations below grade. Where permitted, the cut shall be neat, straight and must stand vertical.

17-11 Reinforcing. Reinforcing bars shall be tied and supported so as to maintain their exact shape and alignment during concrete placement. Lap bars 50 diameters at splices unless noted otherwise.

17-12 Depth of Footings. The elevations of the bottoms of footings, as shown on the plans, shall be considered as approximate only, and the District may order, in writing, such changes in dimensions or elevations of footings as may be necessary to secure a satisfactory foundation. Coarse bedding material shall be placed as a, subgrade below the footing to a minimum depth of twelve (12) inches, under the entire footing of all concrete structures, except standard manholes.

17-13 Control of Water. Water shall be controlled as required in Section 13-05D. Pumping of water from the interior of any foundation enclosure shall be done in such a manner as to preclude the possibility of any portion of the concrete materials being carried away. No pumping will be permitted during the placing of concrete, or for a period of at least twenty-four (24) hours thereafter, unless it be done from a suitable sump separated from the concrete work.

The Contractor shall take all necessary precautions to preclude the discharge of silt or cement fines from newly poured concrete into natural waterways or into sewers.

17-14 Concrete Placement. The Contractor shall notify the District at least seventy-two (72) hours before concrete is placed. No concrete shall be placed until all excavations, forms, reinforcing, and inserts have been constructed and inspected by the District.

All concrete shall be thoroughly vibrated during the pouring operation by a mechanical vibrator. The Contractor shall have a spare vibrator on the job prior to any pour.

17-15 Finishes on Concrete Surfaces. The following specifications set forth the requirements for the classes of surface finish, which shall be applied to the various parts of concrete structures.

- A. Wearing Surface - Unless otherwise specified on the Plans, in the Special Provisions, or directed by the District, the wearing surfaces of concrete steps and concrete walkways, together with the top surfaces of all floors of structures and slabs shall be given a monolithic finish. All surfaces to be finished shall be thoroughly worked and brought to a uniform steel trowel finish. In addition, where directed by the District, stair treads, landings, walkways or floors shall be given a brush or broom finish.
- B. Ordinary Surface Finish - Ordinary Surface Finish shall be applied to all concrete surfaces either as a final finish or preparatory to a higher class finish. On surfaces which are to be buried underground and are in contact with the ground or specified backfill, the removal of fins and form marks and the rubbing of mortared surfaces to a

uniform surface will not be required. Unless otherwise specified, Ordinary Surface Finish shall be considered as a final finish.

During the pouring of concrete, care shall be taken that the methods of compaction used will result in a surface of even texture, free from voids, water or air pockets, and that the coarse aggregate is forced away from the forms in order to leave a mortar surface.

Immediately after the forms have been removed, all form bolts shall be removed to a depth of at least one (1) inch below the surface of the concrete. All holes and depressions caused by the removal or setting back of such form bolts shall be cleaned and filled with a Class II mortar of matching color. Care shall be exercised to obtain a perfect bond with the concrete. All fins caused by form joints and other projections shall be removed and all pockets cleaned and filled. Cement mortar for filling pockets shall be treated as specified for bolt holes. In the judgment of the District, if rock pockets are of such an extent or character as to affect the strength of the structure materially or to endanger the life of the steel reinforcement, he may declare the concrete defective and require the removal and replacement of that portion of the structure affected.

Holes or depressions in surfaces which are to receive Class 1 Surface Finish shall be cleaned and filled with mortar at least seven (7) days prior to starting Class 1 Surface Finish. Exposed mortar shall be wetted with water at intervals during the day for two (2) consecutive days after placing. After the mortar has thoroughly hardened, the surface shall be rubbed with carborundum as required to match the texture and color of the adjacent concrete.

- C. Class 1 Surface Finish - The application of Class 1 Surface Finish shall result in obtaining smooth, even surfaces of uniform texture and appearance, free of unsightly bulges, depressions and other imperfections. The degree of care in building forms and character of materials used in form work will be a contributing factor in the amount of additional finishing required to produce smooth even surfaces of uniform texture and appearance, free of unsightly bulges, depressions and other imperfections, and the District shall be the sole judge in this respect.

Unless otherwise indicated on the plans or in the Special Provisions, all exposed interior and exterior concrete surfaces of all treatment plant and pumping station structures shall be given a Class 1 Surface Finish as a final finish.

After completion of the Ordinary Surface Finish, areas which do not exhibit the required smooth, even surface of uniform texture and appearance shall be sanded with power sanders or other approved abrasive means until smooth, even surfaces of uniform texture and appearance can be obtained.

17-16 Curing. All concrete shall be properly cured in accordance with the requirements of the American Concrete Institute Standard 301.

Forms shall not be stripped until seven (7) days have elapsed after the concrete was poured.

17-17 Concrete Deposited Under Water. In excavations for the footings of proposed structures, if conditions render it impossible or inadvisable in the opinion of the District to dewater the excavation before placing concrete, the Contractor shall deposit under water, by means of a tremie or bottom dump bucket, a layer of concrete of sufficient thickness to thoroughly seal the cofferdam. Concrete deposited in water shall be Class A with ten (10) percent extra cement added. The exact thickness will depend upon the hydrostatic head, but in no case shall the seal be less than eighteen (18) inches. This seal shall, in general, be allowed to remain in place for not less than five (5) days and preferably ten (10) days before dewatering so as to set sufficiently to withstand the hydrostatic pressure.

All portions of the structure for which concrete must be deposited under water shall be poured continuously until completed. When such portions are completed, all scum, laitance, and sediment shall be removed before fresh concrete is deposited. Concrete shall not be placed in running water.

17-18 Waterproofing. When called for on the plans or in the Special Provisions, waterproofing of the type specified shall be installed in accordance with the requirements of Section 54 of the State Standard Specifications or as specified in the Special Provisions.

17-19 Drypack and Special High-Strength Non-Shrink Mortar. Where "drypack" is called for on the plans, a mixture containing one (1) part cement to three (3) parts clean sand shall be used. The moisture content shall be such that the mixture will ball when formed by hand, but will crumble when struck. The mixture shall be confined in the opening to be filled and driven home in small amounts, using a hammer and a stick or blunt metal tool in such a manner that a very dense mortar is obtained. should the resulting joint leak, the material shall be chipped out and the opening refilled until a watertight joint is obtained.

As shown in the plans, the Contractor shall provide concrete bases under all equipment. Cement grout shall be poured under all fabricated metal bases in such a way that all voids are filled with non-shrink mortar, giving support to all parts of the fabricated base. Mortar shall be placed by pouring with enough pressure (head) so that mortar will reach all portions of the fabricated base. A hole shall be drilled in fabricated base at each cell to let out air and a small amount of mortar to assure completely filling each cell.

Mortar used shall be non-shrinking, non-metallic, level-fill grout, water and oil resistant, developing a compressive strength of at least 7,500 psi in seven (7) days, non-metallic and bond to metal. Mortar shall be used in accordance with the recommendations of the manufacturer.

17-20 Alterations to Concrete Structures. All alterations, chipping, drilling or cutting of concrete shall be approved by the District. Where the Contractor is required to cut openings through existing concrete or masonry walls, the hole shall be pre-cut with a proper masonry saw on both sides of the wall. After removal of the concrete, all rough surfaces of the wall shall be ground smooth and patched with cement mortar.

Openings for installation of pipes up to twelve (12) inches diameter shall be machine cored. For larger pipes, openings shall be made by drilling small holes around the periphery prior to chipping out the concrete. After the pipe has been installed, the opening shall be grouted and made completely watertight.

17-21 Grout for Pipes and Anchors. Pipes, anchor bolts, manhole steps or other embedments installed in existing concrete shall be grouted using quick-setting, non-metallic, hydraulic cement. The cement shall be "Waterplug," or "Sika Plug W/C," or equal. The installation shall be made in accordance with the recommendation of the manufacturer.

Where leaks occur in concrete walls, the concrete shall be chipped around the leak and sealed with cement grout above specified, in strict accordance with the manufacturer's instructions.

17-22 Concrete Surface Repairs. Repairs to spalled, cracked, pitted, or crazed concrete surfaces shall be made using Camp Latex Concrete Repair and Topping as manufactured by the Camp Company, Inc., Chicago, IL, or "Sikadur Lo-Mod Mortar" as manufactured by Sika Chemical Corp., Burlingame, CA, or equal. As an alternate, the Contractor may repair concrete surface defects with an approved nonshrink trowel grade epoxy filler, Tnemec 63-1500 filler and surfacer, Will-Cor #900 trowellable putty or equal. The repairs shall be made in strict conformance with the manufacturer's recommendations. For smoothing or repairing large areas that require more than 1/4-inch thickness, special instructions on the use of the material shall be obtained from the manufacturer. The finish painting shall be compatible with the patching material.

17-23 Bonding New Concrete to Old. Where it is required to apply new concrete over old surfaces or to bond precast concrete sections or other types of material to concrete, the Contractor shall first apply a brush-on epoxy resin concrete adhesive equivalent to Concrecive #1 as manufactured by Adhesive Engineering, 1411 Industrial Road, San Carlos, CA, or "Sikadur Hi-Mod" as manufactured by Sika Chemical Corp., Burlingame, CA. The old surface shall be cleaned by sandblasting or chipping and the adhesive applied in strict accordance with the recommendations of the manufacturer.

17-24 Slump Tests. Slump tests shall be performed by the Contractor in the presence of the Inspector at the beginning of each day's pour and at such additional times as required by the District or its representative. Slump tests shall be made in accordance with current ASTM Designation C-143.

The amount of water used in the mixture shall be the amount required to produce concrete with a slump within the range shown as nominal slump in the following table:

<u>Type of Work</u>	<u>Nominal Slump Inches</u>	<u>Maximum Slump Inches</u>
Reinforced concrete structures		
Heavy sections	0-3	5
Thin sections & columns	0-4	6
Non-reinforced facilities	0-3	4
Concrete pavement & walls	0-2	3
Concrete placed under water	6-8	9

When the slump of the concrete is found to exceed the nominal slump, the mixture shall be adjusted as directed by the District to reduce the slump to a value within the nominal range shown.

Where there are adverse or difficult conditions which affect the placing of concrete, the Contractor may request permission of the District to increase the slump by increasing both the water and cement content. The cost of additional water and cement shall be at the Contractor's expense.

17-25 Cylinder Testing. For projects involving the placement of a total of ten (10) cubic yards or more of concrete, the Contractor shall take a minimum of three (3) cylinders for testing by the District.

Additionally, three (3) test cylinders shall be made for each day's pour where more than twenty (20) cubic yards of concrete is poured, or for each 150 cubic yards of concrete placed.

The Contractor shall furnish the cans for the test cylinders and pour the concrete into the cans. The test cans shall be marked with the date and stored on the job site in conditions similar to the structure which was poured. The District will pay for the testing.

17-26 Inspection. The District shall inspect and approve formwork and reinforcing steel placement prior to concrete pours. The Contractor shall provide at least twenty-four (24) hours notice that inspections are required.

SECTION 18 CASTINGS AND METAL FABRICATIONS

18-01 Description. Castings and metal fabrications shall be constructed in accordance with the details shown on the plans, Standard Drawings and as hereinafter specified. The Contractor shall install or erect the metal work, remove the temporary construction, including the removal of the old structure or structures if specified, in accordance with the plans, these specifications and the Special Provisions.

18-02 Materials. The various materials shall conform to the requirements of the specifications of the ASTM as listed in the following tabulation with certain modifications and additions as specified later in this section.

<u>MATERIAL</u>	<u>ASTM DESIGNATION</u>
Structural steel	A-36
Structural silicon steel	A-94
Structural nickel steel	A-8
Low alloy structural steel for welding	A-242
Structural steel for welding	A-373
High-strength structural rivet steel	A-502
Bolts and nuts	A-307
Black steel pipe (std. wt. seamless)	A-120
Carbon steel for forgings	A-235, Class C1
Alloy steel for forgings	A-237, Class A
Cast steel	A-37, Grade 65-35
Cast iron	A-48, Class 30
Malleable iron castings	A-47, Grade No. 32510
Bronze castings	A-22, Class C
Aluminum Alloy GS11A-T6	A-209
Stainless steel forgings	A-473

Materials used in the manufacture of corrugated metal pipes shall conform to AASHTO Designation M-36.

Where the Contractor has been granted permission to substitute rolled stock for forgings, the rolled stock shall meet the physical and chemical requirements for forged steel.

18-03 Structural and Miscellaneous Steel. Steel shapes and plates shall be ASTM A-36. Steel pipes shall be ASTM A-501. Anchor bolts shall be ASTM A-307 with hex heads and nuts. Bolt holes in steel shall be 1/16" oversize, except for holes in column baseplates which may be 1/4" oversize.

Fabrication and erection shall conform to the AISC Specification for the Design, Fabrication and Erection of Structural Steel for Buildings, latest edition. All welding shall conform to the standards of the Structural Welding Code of the American Welding Society and Section 1.17 of the AISC Specification, latest edition. All welders shall be certified by the AWS and approved by the Testing Agency.

18-04 Bolts, Nuts and Washers. Bolts and nuts shall conform to the requirements for regular hexagon bolts and nuts of ANSI B18.2.1 and B18.2.2, respectively. Material shall conform to ASTM A-307. Circular washers for common bolts shall conform to ANSI B27.2, Type A. All bolts, nuts and washers shall be galvanized or Type 316 stainless steel as shown on the plans.

18-05 Galvanizing. Hot dip galvanize all sheet steel, plain or shaped, in accordance with ASTM A-525, Commercial Class 1.25.

Hot dip galvanize all products fabricated from rolled, pressed, and forged steel shapes, plates, bars and strip 1/8-inch thick or heavier in accordance with ASTM A-123.

Hot dip galvanize all steel hardware, nuts, bolts, washers, anchors and threaded rods in accordance with ASTM A-153. Nuts shall be sized so that they screw on threaded bolts readily after galvanizing.

Repair damaged galvanizing by heated repair method. Repair materials shall be Galvalloy, or Gal-Viz, or equal.

18-06 Cast Iron Frames and Covers. Castings shall conform to the shape and dimensions shown on the Standard Drawings. All castings shall be clean and free from blow or sand holes or defects of any kind.

The cover and its seat in the frame shall be machined so that the cover will sit evenly and firmly in the frame.

Cast iron frames and covers shall be dipped or painted with asphalt which will form a tough, tenacious, non-scaling coating which does not have a tendency to become brittle when cold or sticky when hot. Covers shall be easily removable.

18-07 Metal Railings. Metal railings shall be of standard one and one-half inch (1-1/2") galvanized iron pipe, aluminum, or stainless steel, as detailed on the plans. They shall be neatly welded and finished and securely anchored in place in their designated locations. Pin connections shall be used wherever possible. A minimum of field welding shall be made. All steel railings shall be ground smooth and galvanized after fabrication.

The Contractor shall provide suitable chains with eyes welded to the end post or rail at one end, and with snap catch and eye at the other end, at entrance to floor openings and wells within and adjacent to the structure. Chains and eyes shall be ground smooth and galvanized after fabrication.

18-08 Aluminum Fabrications. All aluminum handrails, gratings and frames shall be fabricated in a substantial and workmanlike manner. All grating openings shall be banded, and aluminum angle supports shall be installed as necessary for safety. All grating shall be removable. Grating not secured in position by angles shall be provided with standard bolted aluminum clips or fasteners.

After fabrication, all aluminum material shall be given a clear anodized (electro-chemical) finish conforming to NAAM NA-2A designation to a thickness of 0.7 mils minimum anodized coating.

Where shown, aluminum gratings shall be provided with Type 316 stainless steel hinges and locking hasps. All screws or bolts shall be Type 316 stainless steel. A padlock shall be provided for each lock and grating. The padlock shall be master keyed to the District standard.

18-09 Aluminum Isolation Coatings. Aluminum pigmented asphalt paint shall be used for aluminum in contact with other metals.

All aluminum in contact with concrete shall be coated with an approved isolation coating.

18-10 Cutting with Torch. The use of a cutting torch is permissible if the metal being cut is not carrying stress during the operations. The radius of re-entrant flame cut fillets shall be as large as possible, but never less than one (1) inch. To determine the net area of members so cut, one-eighth (1/8) inch shall be deducted from the flame cut edges. Stresses shall not be transmitted through a flame cut surface.

When cutting with a torch, cuts shall be true to line with a maximum deviation of one-sixteenth (1/16) inch. All burned edges shall be finished by grinding or chipping. The use of the burning torch will be permitted on ends that form compression connections, providing a minimum of one-quarter (1/4) inch of metal is left to be removed by machining.

18-11 Painting. All iron and steel surfaces shall be cleaned and painted in accordance with the requirements of Section 19 of these specifications.

18-12 Inspection. All castings and fabrications shall be inspected and approved prior to installation. The acceptance of any material or finished members by the Inspector shall not be a bar to their subsequent rejection, if found defective. Rejected material shall be immediately removed from the site and replaced promptly by the Contractor.

SECTION 19 PAINTING

19-01 Description. Painting shall include the furnishing of all plant, labor, equipment, appliances, and material and the performing of all operations in connection with the preparation of surfaces, application of all paint or other materials and the manufacture of paints, paint material and miscellaneous materials incidental thereto. Surfaces to be painted shall receive treatment and the number of coats prescribed herein, or as detailed on the plans or in the Special Provisions. Paint colors shall be those specified and approved by the District.

19-02 Standards.

- A. Painting Standards - All painting shall be done in accordance with Section 59 of the State Standard Specifications, State of California, Department of Transportation, latest edition.
- B. Products - All materials, supplies and articles furnished shall, wherever practicable, be the standard product of a recognized, reputable manufacturer. The standard products of manufacturers other than those specified will be accepted when it is proved to the satisfaction of the District that all paint materials comply fully with the specifications.
- C. Metal Surfaces - Metal surfaces shall be prepared and painting shall be done in accordance with Steel Structures Painting Council (SSPC) Specifications.

19-03 Safety. Paint materials shall be stored in assigned area, and storage area shall be kept clean and fire safe. Used rags, thinner and buckets shall be disposed of daily.

The Contractor is advised that application of coal tar epoxy and other paint materials may be hazardous. The Contractor shall take all necessary precautions to ensure the safety of workers and property.

The Contractor shall maintain a copy of the Material Safety Data Sheets (MSDS) for all coating materials on the job site at all times.

19-04 Air Quality Standards. All work, materials, procedures and practices under this section shall conform with requirements of the Bay Area Air Quality Management District.

19-05 Epoxy Filler and Surfacer Compound. Epoxy filler and surfacer compound for concrete surfaces shall be non-shrink, trowel grade filler and surfacer with high bond strength and high resistance to abrasion, impact, wet conditions, corrosive fumes, solvents and chemical contact. Filler and surfacer compound shall be Tnemec 63-1500 epoxy putty, Wil-Cor #900 trowellable epoxy putty, or equal 100% solids epoxy patching material.

One (1) coat of Tnemec Series 69, Koppers Hi Guard Epoxy, or equal shall be sprayed on the concrete for the purpose of highlighting the large holes and defects in the concrete surfaces.

The epoxy filler and surfacer compound shall be troweled into the big holes and defects in the concrete surface. The troweled thickness over damaged concrete surfaces shall be 1/32" to 1/16".

19-06 Coating Systems.

Coating System

Designation

Paint Specification

A

Surface Preparation: Steel - SSPC-SP-10 (near white metal blast cleaning)
Concrete - Brush-off blast

System: High-Build Coal Tar Epoxy

Paint Types: Tnemec Series 46H-413 High-Build Tnemec Tar
or

Two (2) coats Koppers 300M Coal Tar Epoxy
Self-Priming

Primer: Steel - Two coats

Coats: Total 16-20 mils dry film thickness

Concrete - Two coats

Base coat 4.0-6.0 mils

Top coat 12.0-14.0 mils

Total 16-20 mils dry film thickness

B

Surface Preparation: Steel - SSPC-SP-10 (near white metal blast cleaning)
Concrete - Brush-off blast

System: High-Build Epoxoline

Paint Types: Tnemec Series 69
Koppers Hi-Gard Epoxy

Primer: Steel: Self priming
Concrete: Thin paint to provide 2 mils dry film
thickness, apply epoxy filler and surfacer
compound (See 19-05)

Coats: Two (2) coats
each coat 5.0-7.0 mils dry film thickness

Total 10.0-14.0 mils dry film thickness

C

Surface Preparation: SSPC-SP-6 (commercial blast cleaning)

System: High-Build Epoxoline base coat
Alkyd Polyurethane Enamel top coat

Paint Types: Tnemec Series 69 base coat
Tnemec Series 75 top coat

Or

	Koppers Hi-Gard Epoxy base coat
	Equivalent Koppers top coat
Primer:	Tnemec 606 base coat
	Compatible Koppers primer
Coats:	Two (2) coats
	Base coat 4.0 mils
	Top coat 4.0 mils
	Total 8.0 mils dry film thickness

19-07 Preparation of Surfaces. All surfaces to be painted shall be thoroughly cleaned before applying paint or surface treatments, including sealing of all surface markings that may bleed through. Clean clothes and clean fluids shall be used in solvent cleaning to avoid leaving a thin film of greasy residue. Cleaning and painting shall be so programmed that dust or spray from the cleaning process will not fall on wet, newly painted surfaces. Hardware, and similar accessories shall be removed or suitable masked during preparation and painting operations, or shall otherwise be satisfactorily protected. In all cases the recommendations of the paint manufacturer shall be rigidly followed in the preparation of surfaces prior to painting.

After the Contractor has completed the job of preparing all surfaces to be painted, the surfaces shall be inspected and approved by the District prior to the application of any paint.

- A. Metal Surfaces - All metal surfaces to be painted shall be prepared by sandblasting pursuant to the requirements of Section 19-06 and shall be completely clean and free of all oil, grease, dirt, rust, loose mill scale, old weathered paint, and other foreign substances. The removal of oil and grease shall, in general, be accomplished by sandblasting. Minor amounts of grease and oil contaminants will be tolerated on the surface, prior to sandblasting, provided that the abrasive is not reclaimed and reused. All galvanized metal shall be thoroughly washed with neutralizing solution prior to painting.
- B. Concrete Surfaces - All concrete surfaces to be painted shall be prepared by sandblasting pursuant to the requirements of Section 19-06 and shall be completely clean and free of all oil, grease, dirt, etc., and shall be completely wire brushed to remove any loose concrete or paint and all cracks shall be patched to the satisfaction of the District. Surfaces to be painted with coal tar epoxy shall be sandblasted to remove the smooth surface mortar in accordance with the recommendations of the paint manufacturer.

19-08 Paint Applications.

- A. Workmanship - All work shall be done in strict accordance with the instructions of the paint manufacturer and in a workmanlike manner so that the finished surfaces will be free from runs, drops, ridges, waves, laps and unnecessary brush marks. All coats shall be applied in such manner as to produce an even film of uniform thickness

completely coating all corners and crevices. All painting shall be done by thoroughly experienced workmen. Care shall be exercised during spraying to hold the nozzle sufficiently close to the surfaces being painted to avoid excessive evaporation of the volatile constituents and loss of materials into the air, or the bridging over of crevices and corners. Spray equipment shall be equipped with mechanical agitators, pressure gauges, and pressure regulators. Nozzles shall be of proper size. Floors, roofs, and other adjacent areas and installations shall be satisfactorily protected by drop cloths or other precautionary measures. All overspray shall be removed by approved method or the affected surface repainted.

The District shall be notified when each coat has been applied and is ready for inspection. Until each coat has been inspected and approved by the District, no succeeding coats shall be applied.

- B. Atmospheric Conditions - Except as specified or required for certain water-thinned paints, paints shall be applied only to surfaces that are thoroughly dry and only under such combination of humidity and temperatures of the atmosphere and surfaces to be painted as will cause evaporation rather than condensation. In no case shall any paint at all be applied during rainy, misty weather or to surfaces upon which there is frost or moisture condensation, without suitable protection as approved by the District. Where painting is permitted during damp weather, or when the temperature is at or below 50 degrees F, the surfaces shall be heated to prevent moisture condensation thereon. Bare metal surfaces, except those which may be warped by heat, may be dehydrated by flame-heating devices immediately prior to paint application. While any painting is being done, the temperature of the surfaces to be painted and of atmosphere in contact therewith, shall be maintained at or above 50 degrees F, except where paints are being used which dry solely by evaporation, in which case the temperature of the air and surface may be 35 degrees F or as approved by the District. All paint when applied shall be approximately the same temperature as that of the surface on which it is applied.
- C. Protection of Painted Surfaces - Where protection is provided for paint surfaces, such protection shall be preserved in place until the paint film has properly dried, and the removal of the protection is authorized. Items which have been painted shall not be handled, worked on or otherwise disturbed until the paint coat is completely dry and hard. After delivery at the site, all shop coated metalwork shall be repainted or retouched from time to time with specified paint whenever, in the opinion of the District, it becomes necessary to maintain the integrity of the film.

19-09 Painting Schedule. Various items shall be painted in accordance with the painting schedule given below. Coating systems refer to those listed in Section 19-06.

<u>Surface Location</u>	<u>Coating System Designation</u>
All concrete and metalwork submerged or exposed to moisture or sewage, such as wet wells, weirs, gates, pipework (not manholes), etc.	A or B
All exposed interior and exterior concrete surfaces, such as pump station and structure walls, ceilings, etc. (not floors).	B
All concrete and metalwork submerged or exposed to moisture or sewage, such as wet wells, weirs, gates, pipework (not manholes), etc.	C

19-10 Cleanup. Upon completion of his work, the painting contractor shall remove his surplus materials. All paint spills shall be removed and the entire premises shall be free from rubbish, debris, etc., caused by his work. He shall present the work clean and free from blemish so that it is acceptable in every way. All glass and equipment name tags shall be thoroughly cleaned of paint spots and polished, and the job made ready for use.

SECTION 20 SURFACE RESTORATION

20-01 Description. Surface restoration shall include the furnishing of all labor, material, equipment, tools, and services required for the performance of paving and surfacing operations, including repair of curbs, gutters, sidewalks, as well as public and private driveway and sidewalk areas, as specified here and/or as shown on the drawings or as necessary to complete the project. Any concrete curbs, gutters or sidewalks damaged by the work shall be repaired or replaced in kind.

No surface restoration shall be performed until all compaction tests have been made and passed and until approved by the District.

20-02 Air Quality Control Board Regulations. The Contractor shall use materials which comply with the Bay Area Air Quality Management District.

20-03 Pavement Restoration. Pavement restoration for public roads shall conform to the requirements of the agency having jurisdiction over the roadway right-of-way. Materials for paving and surfacing shall conform to the applicable provisions of the State Standard Specifications and the County Specifications.

Pavement thickness shall match the thickness of the adjoining pavement or the thickness indicated on the drawings, whichever is greater.

20-04 Pavement Cutting. Trenches and other excavations in asphalt paved areas shall be cut by means of a saw or jackhammer equipped with a spade tool to the full depth of the pavement as required by the agency having jurisdiction over the street. Pavement cuts shall be laid out by a chalk line and care shall be taken to ensure neat, straight edges.

After the District has approved a section of trench for final paving, the Contractor shall strip out all temporary pavement to the full depth of the new pavement section as specified. Spalled or cracked sections of pavement beyond the excavation limits which, in the opinion of the District, show signs of having separated from the adjoining pavement or are moveable, shall be removed and replaced with new pavement. Broken edges of pavement shall be trimmed along lines parallel to the trench edges. Exposed subgrade materials shall be compacted to the same standards as the adjoining trench backfill.

20-05 Pavement Grinding - Where required, existing pavement shall be ground down to make a smooth joint with existing gutters and joints with existing pavement. All pavement grinding shall be done in accordance with Section 42 of the State Standard Specifications.

20-06 Aggregate Base. Aggregate base shall be Class 2, conforming to Section 26 of the State Standard Specifications. Minimum relative compaction shall be 95%. Base shall be placed and compacted prior to placing of temporary paving.

20-07 Asphalt Concrete. Asphalt concrete shall conform to the applicable requirements of Section 39 of the State Standard Specifications for Type B aggregate or as modified by the agency with jurisdiction over the street. Paragraph 39-8 is not applicable. Surface courses shall be constructed using ½-inch maximum graded aggregate. Lower courses shall be constructed using ¾-inch maximum graded aggregate.

Paving asphalt shall be Grade AR-4000, conforming to the requirements of Section 92 of the State Standard Specifications. Four to six percent (4-6%) bituminous binder shall be provided.

Bituminous mixtures shall be delivered to the roadbed at temperatures specified in Section 39 of the State Standard Specifications. Spreading of the mixture shall be in accordance with Section 39 of the State Standard Specifications. All loads shall be covered with tarpaulin or other material during transportation.

Initial or breakdown rolling and the final rolling of the uppermost layer of the asphalt concrete shall be compacted in accordance with Section 39 of the State Standard Specifications. Compaction by vehicular traffic shall not be permitted.

The joints between old and new pavements or between successive days' work shall be carefully made in such manner as to insure a continuous bond between old and new sections of the course. After the trench has been backfilled, edges of the existing pavement shall be exposed and cleaned and retrimmed to straight, vertical surfaces. All joints shall be painted with a uniform coat of tack coat before the fresh mixture is placed. Each lift of asphalt concrete shall be allowed to cool down before the next lift is placed. Before the final lift of asphalt concrete is placed, the edges of the trench shall be tacked with RS-1 asphaltic emulsion.

20-08 Slurry Seal. Where shown on the plans, the Contractor shall place a slurry seal. Slurry seal materials shall conform to the requirements of the State Standard Specifications, Section 37-2.

20-09 Conformance to Existing Improvements. Asphalt concrete overlays shall be tapered to conform to existing paving, gutters, catch basins, etc.

20-10 Raising Existing Castings to Grade. After the final paving is placed, the Contractor shall raise all existing monuments, valves, manholes and other castings to the final surface elevation. The method of raising the castings to grade shall conform the requirements of the agency having jurisdiction over the street.

20-11 Restoration of Striping and Pavement Markers. After the final paving is complete, the Contractor shall stripe the new pavement and provide new pavement markers and delineators to replace the old ones. Traffic stripes and pavement markings shall conform to Sections 84

and 85 of the State Standard Specifications. Markers and delineators shall conform to Section 82 of the State Standard Specifications. No work shall be done until the layout is approved by the agency having jurisdiction over the street. Restoration of striping and pavement markings shall be included in the cost of pavement restoration.

20-12 Unpaved Travel Surfaces. Trenches in unpaved areas of private streets shall be surfaced with a minimum of twelve (12) inches of Class 2 Aggregate Base.

20-13 Concrete Surfaces. All concrete curbs, gutters, aprons, patios, driveways and sidewalks which are broken, cracked or damaged by installation of the improvements shall be reconstructed by and at the expense of the Contractor, of the same kind of material and of the same dimensions as the original work, conforming to the requirements of Section 43 of the County Specifications. The repairs shall be made by removing and replacing the entire portions between joints or by removing the damaged portions by concrete saw and not be merely refinishing the damaged part. All work shall match the appearance of the existing improvements as nearly as practicable. Lamp black or other pigments may be added to the concrete to obtain the necessary result.

20-14 Landscaped or Cultivated Areas. All excavations or trenches in landscaped or cultivated areas shall have the top twelve (12) inches backfilled with top soil. The top soil shall consist of fertile, friable soil of loamy character conforming to the requirements of Section 20-2.01 of the State Standard Specifications or as specified in the Special Provisions. With specific approval from the District, the Contractor may use top soil taken from the excavation. After installation, the top soil and any adjacent unimproved land which has been compacted by the operations of the Contractor shall be thoroughly scarified and the surface cleared of all large clods, stones or debris.

