DIVISION THREE - MATERIALS AND CONSTRUCTION

SECTION 301 TRANSMISSION AND DISTRIBUTION PIPE MATERIALS

Section 301.01 Description - All pipelines constructed for the purpose of conveying potable water from a source, storage facility, pumping facility, or treatment facility to the point of use shall be defined as transmission and distribution pipelines. This definition shall also include but not be limited to, piping assemblies at such facilities, fire hydrant laterals, and services 3-inch and larger to the meter.

All pipe, and pipe or plumbing fittings shall be certified by an independent ANSI-accredited third party, including, but not limited to, NSF International, as being in compliance with Section 116875(g) of the California Health and Safety Code.

Beginning January 1, 2010, all pipe, and pipe or plumbing fittings intended to convey or dispense water for human consumption shall be lead free. "Lead free" means not more than a weighted average of 0.25% with respect to the wetted surface area, in accordance with Section 116875 (e) of the California Health and Safety Code.

Services smaller than 3-inch, fittings, valves, and appurtenances shall be installed and constructed in accordance with other sections of these Standard Specifications and the *Contract Documents*.

Section 301.02 Poly Vinyl Chloride (PVC) Pipe

Section 301.02.01 General - All polyvinyl chloride (PVC) pipe shall be cast-iron-equivalent outside diameter with push-on bell type joints. Each joint shall be equipped with one elastomeric gasket. Each full length of pipe (20-feet) shall be provided with one bell type joint. Pipe wall thickness by pressure class and dimension ratio shall be as follows:

Pressure Class	Dimension Ratio (DR)
100	Not permitted
150	18
200	14

Section 301.02.02 Pipelines 12-inch and Smaller - Except as called for in the *Contract Documents*, all transmission and distribution water mains 12-inches in diameter and smaller shall be constructed of polyvinyl chloride (PVC) pipe conforming with the requirements of AWWA C900. (PWPipe, Johns-Manville or approved substitute.)

Section 301.02.03 Pipelines 14-inch and Larger - Except as called for in the *Contract Documents* all transmission and distribution mains 14-inches in diameter and larger shall be

constructed of polyvinyl chloride (PVC) pipe conforming with the requirements of AWWA C905. (PWPipe, Johns-Manville or approved substitute.)

Section 301.03 Ductile Iron Pipe - Where called for in the *Contract Documents* or at the Contractor's discretion and subject to the prior approval of the Engineer, transmission and distribution water mains may be constructed of cement-mortar lined, centrifugally cast ductile iron pipe conforming with the requirements of AWWA C151, Class 50. Joints shall be of the push-on bell type with restraining gaskets. Each full length of pipe (18-feet) shall be provided with one bell type joint. Cement-mortar lining shall conform with the requirements of AWWA C104 (U.S.Pipe TYTON®, FIELD-LOK®, TRFLEX® or approved substitute.)

Section 301.04 Welded Steel Pipe

Section 301.04.01 General - Welded steel pipe shall only be used for above ground piping assemblies including but not limited to, storage tank piping, pump stations, treatment plants, and wells. Welded steel pipe shall not be used for any subsurface pipeline installation without first obtaining the express written approval of the Engineer prior to commencing work.

Welded steel pipe shall be used for pump suction barrels.

Section 301.04.02 Materials - All welded steel pipe shall conform with the requirements of AWWA C200 for welded steel pipe. Fittings for welded steel pipe shall be in accordance with Section 303.03, "Welded Steel Fittings and Specials" of these Standard Specifications.

Section 301.04.03 Field Welding - All field welding of steel pipe shall be in accordance with AWWA C206. The welder shall be certified in accordance with AWWA C206 and a current record of such certification shall be submitted to the Engineer prior to commencing work in accordance with Section 107.10, "Submittals" of these Standard Specifications. Field welding shall only be performed upon the direction of the Engineer or as provided for in the *Contract Documents*. Field welding shall not normally be considered an acceptable method for the installation and construction of piping assemblies. All field welds that are permitted shall be immediately recoated in accordance with AWWA C213, Section 3.5.

Section 301.04.04 Coatings - All welded steel pipe shall be fusion bonded epoxy coated inside and out after fabrication in accordance with AWWA C213. The Contractor shall every take precaution including but not limited to, the use of fabric hoisting slings and protective wrappings, to protect the coating from damage during transport and installation. Any damage found shall be immediately repaired in accordance with AWWA C213, Sections 3.4 and 3.5.

Section 301.05 Construction, Fabrication, and Installation

Section 301.05.01 Trenching - The Contractor shall bear full responsibility for safety related to his trenching operations in accordance with Section 104.07, "Public Safety" and Section 104.08, "Industrial Safety Orders" of these Standard Specifications.

Trenching, bedding, and backfill operations including but not limited to, pavement cutting and restoration, excavation, shoring, and steel plates shall be in accordance with Section 309, "Bedding, Backfill, and Aggregate Base" of these Standard Specifications. Insofar as practicable and at all times on grades in excess of 1-foot horizontal to 10-feet vertical (10 percent), trenching and pipelaying operations shall proceed uphill from the lowest point with the bell end leading.

Section 301.05.04 Daily Limits - The Contractor shall excavate only that length of trench in which he can safely and properly install pipe and backfill daily. No trenches may be left open when the Contractor is not actively

prosecuting work related to that trench. To facilitate the prosecution of the work, the Contractor may request to use plates to cover open trenches. The use of steel plates shall be dependent upon the prior approval of the Engineer.

Section 301.05.05 Handling and Placing - The Contractor shall employ such devices and equipment as will enable the pipe to be transported, stored, and installed in its final location or configuration, as provided for in the *Contract Documents*.

Pipe to be installed in trenches shall be lowered into the trench using lowering slings and other devices that will prevent an uncontrolled drop into the trench. Compacted bedding material conforming with Section 309, "Bedding, Backfill, and Aggregate Base" of these Standard Specifications shall be installed in the bottom of the trench and compacted prior to placing pipe in the trench. Bell holes shall be excavated such that the pipe is fully supported by the pipe barrel. Pipe shall not be permitted to be supported solely by the bells. Where the *Contract Documents* call for or the Contractor elects to use sand/cement slurry backfill material, the pipe shall be supported on wooden blocks or other supports on each side of every joint. An additional block at mid-span shall be used for PVC pipe. Such blocks shall be of such dimension as to raise the pipe high enough to clear the bells and long enough to span at least _ of the trench width. Wooden blocks shall be redwood or pressure treated timber.

Section 301.05.06 Locator Wire - A wire to be used for future subsurface location shall be installed concurrent with pipe laying operations. The wire shall be a minimum of 12 gauge THW or THWN and shall be continuous for the entire length of pipe laid. The wire shall be secured to the pipe by either tape, mastic, or looping at a maximum interval of 12 feet. Connections between lengths of wire shall be made either by crimp connectors, or wire nut connectors. Each connection shall be at least double-wrapped with PVC electrical tape with each turn lapping the previous turn by at least 50-percent. The wire shall be brought to the surface in each valve box with at least 2 feet of wire more than that required to reach the surface. The wire shall be protected during backfilling operations to prevent displacement or continuity breaks. Any damage to the locator wire shall be immediately repaired.

Section 301.05.07 Hydrostatic Testing - Upon completion of pipeline construction, the Contractor shall fill the pipeline with water from an approved source, normally the existing pipeline to which the new pipeline will be connected. The District will provide the water for hydrostatic testing up to and including one retest of the pipeline. Water necessary for all additional hydrostatic test may be charged to the Contractor in accordance with Section 104.13, "Charges to the Contractor" of these Standard Specifications. All work involved in hydrostatic testing of pipelines shall conform to the requirements of AWWA C600, these Standard Specifications, and the provisions of the *Contract Documents*.

The Contractor shall provide all pumps, fittings, labor, equipment, and materials and all assistance necessary, including but not limited to, temporary thrust restraint and connection to the supplying water source for the hydrostatic testing of all pipelines. Hydrostatic testing shall be performed in the presence of the District Inspector. Test pressures shall be a minimum of 150 psi or 150-percent of the service pressure for the pipeline, whichever is the greater. At no time shall the test pressure be allowed to exceed the working pressure rating of the weakest pipe, valve, fitting, or service on the line to be hydrostatically tested.

Test pressures shall be held for a minimum of 2 hours or that period of time provided for in the *Contract Documents*. During the hydrostatic test the pressure shall not be allowed to vary more than 5 psi above or below the required test pressure. Tests shall not be held against closed line valves without the prior approval of the Engineer and all hydrant valves shall be open. Where service lines have been installed prior to conducting the hydrostatic test, the service line to the meter stop shall be included in the test. An additional allowance of 0.0078 gph/inch of service line diameter may be included for each service line included in the hydrostatic test in the calculation of allowable leakage in such cases.

Upon completion of pipeline construction all pipelines and pump suction barrels shall be hydrostaticly tested and observed for leaks. The Contractor shall schedule the hydrostatic test with the Engineer at least 24 hours in advance of the test. The pipelines or pump suction barrels shall be filled and carefully brought to the test pressure. Failure of any portion of the system shall be cause for rejection and the Contractor shall promptly identify and correct the deficiencies causing the failure. The hydrostatic test shall be repeated until a satisfactory test is achieved. All visible leaks shall be promptly repaired regardless of the actual leakage measured.

This procedure shall be followed until an acceptable test is achieved. The Contractor may be charged for the Engineer's time for reinspection for all tests past the first retest in accordance with Section 104.13, "Charges to the Contractor" of these Standard Specifications.

Section 301.05.07(a) Allowable Leakage - The allowable leakage will be calculated by the following formula:

$$L_a = \{LD\sqrt{P}\}/133,200$$

where: L_a = Allowable leakage
L = Length of the pipe run
D = Nominal diameter of the pipe in inches
P = Test pressure

Allowable Leakage per 1000 ft of Pipeline - *gph*

Nominal Pipe Diameter - *in.*

Avg. Test Pressure	4	6	8	10	12	14	16
150	0.37	0.55	0.74	0.92	1.10	1.29	1.47
175	0.40	0.59	0.80	0.99	1.19	1.39	1.59
200	0.43	0.64	0.85	1.06	1.28	1.48	1.70
225	0.45	0.68	0.90	1.13	1.35	1.58	1.80
250	0.47	0.71	0.95	1.19	1.42	1.66	1.90
275	0.50	0.75	1.00	1.24	1.49	1.74	1.99
300	0.52	0.78	1.04	1.30	1.56	1.82	2.08

The allowable leakage for differing lengths of pipe runs and higher test pressures will be provided for in the *Contract Documents* or by direction of the Engineer. The allowable leakage for test sections of differing diameters will be calculated as the sum of the computed leakage for each size.

Section 301.05.07(b) Equipment - The Contractor shall provide a test pump capable of supplying 300 psi static pressure, a means of adding replacement water during the test, and gauges and meters to monitor the pressure and replacement water used.

Section 301.05.08 Disinfection - All disinfection will be performed by District forces. The Contractor shall provide all access to the pipe to be tested, including service taps for chlorination in accordance with Standard Detail S-14, "Chlorination Tap" of these Standard Specifications. Upon completion of chlorination and a satisfactory test, the Contractor shall remove the service pipe, meter stop, and the meter box and restore the surface to its final condition as described elsewhere herein. In environmentally sensitive areas and when provided for in the *Contract Documents*, the Contractor shall neutralize the chlorine laden water with a solution of sodium thiosulfate prior to disposing of disinfection water. Insofar as practicable, locations of chlorine taps and blow-offs for flushing will be shown on the project plans. The Contractor shall provide an allowance in his proposal for the cost of all chlorine taps shown plus at least 2 additional taps that may be required by field conditions.

Upon completion of disinfection, the line will be flushed by District forces using the blow-off points indicated on the plans. The Contractor shall assist the District forces in this flushing operation including but not limited to, providing

water trucks, hoses, valves, neutralizing chemicals, and directing the discharge to a safe disposal point.

Upon completion of disinfection and flushing, the District Inspector shall take a water sample from the new pipeline for bacteriological analysis. The Contractor shall allow a period of 2 working days from the time the sample is taken until the results are available. No bacteriological samples will be taken for analysis by the District laboratory after noon on Thursdays.

In lieu of availing himself of the District laboratory for bacteriological analysis, the Contractor shall have the option of hiring his own laboratory to perform the analysis. If the Contractor elects to use an independent laboratory, such laboratory shall have the prior approval of the Engineer. The District Inspector shall take the sample and deliver the sample to the Contractor in a sealed bottle with a District transmittal form. The Contractor shall then deliver the sample to the laboratory and return the transmittal form and a minimum of 3 copies of the test results to the Engineer. The sample shall not be considered acceptable until written approval of the Engineer is received by the Contractor.

Section 301.06 Measurement - Quantities of transmission and distribution pipeline will be measured to the nearest 2 foot increment or portion thereof along the centerline of the pipeline as constructed. Except as provided for in the *Contract Documents*, all fittings and thrust restraint systems installed as part of such pipeline shall be considered as incidental to the construction of such pipelines and no additional compensation will be allowed therefor.

Except as provided for in the *Contract Documents*, quantities of pipeline constructed as part of piping assemblies including but not limited to, that piping for wells, booster stations, and tanks shall be considered as incidental to the construction of such piping assemblies and no additional compensation will be allowed therefor.

Section 301.07 Payment - The contract unit price paid per linear foot for PolyVinyl Chloride (PVC) Pipe or Ductile Iron Pipe shall include full compensation for furnishing all labor, tools, equipment, materials, and incidentals and for doing all work involved in construction of the pipeline complete in place, including but not limited to, excavation, bedding, backfill, pavement repair, handling and transportation, thrust restraint, fittings, corrosion protection, and hydrostatic testing as specified in these Standard Specifications and as provided for in the *Contract Documents*.

Where provided for in the *Contract Documents*, the contract unit or lump sum price paid for piping assemblies shall include full compensation for furnishing all labor, tools, equipment, materials, and incidentals and for doing all work involved in construction of the pipeline complete in place, including but not limited to, excavation, bedding, backfill, pavement repair, handling and transportation, thrust restraint, fittings, corrosion protection, and hydrostatic testing as specified in these Standard Specifications and as provided for in the *Contract Documents*.

SECTION 302 SERVICE PIPE MATERIALS

Section 302.01 Description - Service pipe materials shall be defined as all pipe and tubing necessary to convey potable water from a transmission or distribution pipeline to the point of use. Service pipe materials shall also include all pipe and tubing included as a portion of or integral to appurtenances, pumps, and tanks and all fittings necessary for the construction or installation of service pipe materials.

All pipe, and pipe or plumbing fittings shall be certified by an independent ANSI-accredited third party, including, but not limited to, NSF International, as being in compliance with Section 116875(g) of the California Health and Safety Code.

Beginning January 1, 2010, all pipe, and pipe or plumbing fittings intended to convey or dispense water for human consumption shall be lead free. “Lead free” means not more than a weighted average of 0.25% with respect to the wetted surface area, in accordance with Section 116875 (e) of the California Health and Safety Code.

Except as provided for elsewhere herein or in the *Contract Documents*, all pipeline and services larger than 3-inch in diameter shall be provided, constructed or installed as provided for in Section 301, "Transmission and Distribution Pipelines" of these Standard Specifications.

Section 302.02 Polyethylene Tubing

Section 302.02.01 Materials - All service lines less than 3-inches in diameter shall be constructed of virgin polyethylene material conforming with the provisions of AWWA C901 for Pressure Class 200 and Dimension Ratio (DR) 9.

Section 302.02.02 Fittings - All connections to fittings shall include the use of stainless steel inserts to prevent the collapse of the tubing wall and pullout. Each fitting to tubing connection shall of the pack joint or grip joint type with insert, gasket, packing joint nut, and grooved clamp with stainless steel clamp screw.
Corporation stops shall be red brass, male iron pipe thread (MIPT), plug style valves conforming with the requirements of AWWA C800 (Ford F1100 or approved substitute.)

Angle meter stops shall be inverted key type manufactured of red brass conforming with the requirements of AWWA C800 (Ford KV43-444W and A34S Adapter Bushing; no substitute.)

Service tapping saddles shall be red brass, female iron pipe thread (FIPT) 2 piece saddles hinged to facilitate installation around the pipe conforming with the requirements of AWWA C800 (Ford 101BS, 202BS, Jones J975, J995, J996, or approved substitute.)

Couplings for reconnection to existing polyethylene tubing shall be straight red brass compression type with insert, gasket, packing joint nut, and grooved clamp with stainless steel clamp screw (Ford C44 series or approved substitute.)

Section 302.02.03 Construction - Service lines shall be constructed of one continuous piece of polyethylene tubing between the corporation stop and the meter stop. The main shall be tapped with a drilling machine specifically designed for tapping transmission and distribution water mains (Ford Model 77 or approved substitute.) Service taps shall spaced a minimum of 2-feet apart along the length of the main.

In laying the service tubing the Contractor shall ensure that the tubing is not subject to point loads due to sharp rocks within the excavation, kinking or crimping, cuts, scratches, or abrasions, or prolonged exposure to sunlight. At the Contractor's option and subject to the approval of the Engineer, service lines may be installed by the directional boring method. The Contractor shall bear full responsibility for the operation of the boring equipment, protection of utilities, and the proper installation of the service piping.

All tubing shall be cut using a cutter designed for cutting polyethylene tubing. Pinching or squeezing off of the tubing will not normally be permitted. In the event that pinching off becomes necessary, the Contractor shall use a roller type device designed for the purpose and shall not overtighten the pinch beyond the point necessary to enable working on the service. Upon completion of the work on the service line, the Contractor shall ensure that the pipe or tubing has been restored to a round shape with no evidence of stress cracks, splits, leakage, or other damage that will impair the serviceability of the material. Evidence of damage shall be cause for total replacement of the damaged material to a minimum of 12-inches on each side of the damaged section. Replacement of the entire service may not be required. Damaged tubing shall be removed and replaced in accordance with the provisions of these Standard Specifications.

A wire to be used for future subsurface location shall be installed concurrent with pipe laying operations. The wire shall be a minimum of 12 gauge THW or THWN and shall be continuous for the entire length of service pipe laid. The wire shall be secured to the pipe by either tape, mastic, or looping at a maximum interval of 12 feet. Connections between lengths of wire shall be made either by crimp connectors, or wire nut connectors. Each connection shall be at least double-wrapped with PVC electrical tape with each turn lapping the previous turn by at least 50-percent. The wire shall be brought to the surface in each meter box with at least 2 feet of wire more than that required to reach the surface. The wire shall be protected during backfilling operations to prevent displacement or continuity breaks. Any damage to the locator wire shall be immediately repaired. The locator wire for the service pipe shall not be connected to the locator wire for the main pipeline except as provided for in the *Contract Documents* or as directed by the Engineer.

In approaching and leaving fittings and meters, the tubing shall not be bent in a curve with a radius tighter than 30 times the nominal diameter of the tubing. A straight run of tubing at least 10 times the nominal diameter shall be provided on each side of each fitting.

Care shall be taken to ensure that the drilling machine is securely fastened to the service tapping saddle through the corporation stop. The Contractor shall use the appropriate cutting tool for the material of the pipeline. A shell cutter or hole saw type cutter will be required for use on PVC pipelines.
Use of a drill type cutter on PVC pipelines shall be grounds for immediate rejection of the tap. The Contractor shall remove the tapping saddle and a section of pipeline for a minimum of 2-1/2 feet on each side of the tap. A new section of pipeline shall be installed using mechanical joint couplings with restraining glands. A new tap shall then be made in the center of the replaced section using the correct cutter.

The tap shall be made through the corporation stop whether or not the pipeline is under pressure. The Contractor shall be responsible for the selection of the cutter, adapter, and boring bar required for the installation. Upon confirming that the corporation stop is fully open the Contractor shall advance the cutter to contact the pipe wall. Once the tapping operation commences, the Contractor shall maintain a steady gentle pressure on the feed screw and shall advance the cutter through the pipe wall in one continuous and smooth operation.

Upon completion of the tap, the Contractor shall carefully remove the cutter assembly and the pipewall coupon from the corporation stop and close the stop. Upon relieving the pressure in the tapping tool, the Contractor shall remove the tapping machine from the corporation stop and inspect the stop for damage, debris and leaks.

Any damage to the stop or the tapping tee including but not limited to evidence of overtightening, misaligned threads, burring or scarring of machined faces, or any evidence of leakage shall be cause for rejection. Evidence of damage shall be cause for rejection of the stop and tapping tee, whether or not there is evidence of leakage.

If a leak is found to be caused by debris, the debris shall be cleared and the stop or tapping tee visually inspected for damage before being charged. If the leak recurs upon charging of the line, the stop or tapping tee shall be removed and replaced whether or not the cause can be determined.

Immediately prior to interrupting the customer's service as part of reconnecting existing services, the Contractor shall notify the customer of the interruption, the anticipated duration, and that the line will be flushed immediately after restoring service. The Contractor shall provide every assistance to the customer during the disruption of service including but not limited to scheduling around the special needs of the customer, prosecuting his work as expeditiously as possible, and restoring and flushing the service line at the earliest opportunity.

Upon completion of the installation of the service piping and connection or reconnection to customer plumbing, the Contractor shall flush the service and customer plumbing for a minimum of 5 minutes or until the discharge is clear. Flushing shall be performed at the hose bib nearest the house shutoff valve. The hose bib shall be opened prior to opening the meter stop.

Section 302.03 Copper Tubing

Section 302.03.01 Materials - Copper tubing shall be Type "K" soft seamless copper tubing conforming with the requirements of ASTM B88, Type K. Copper tubing shall only be used as incidental material in the installation of above grade piping assemblies.

Except as provided for in the *Contract Documents*, fittings for Type "K" copper tubing shall be of the Grip Tite™,pack joint, or compression type conforming with the requirements of AWWA C800, Section 5.

Section 302.03.02 Construction - Threads of fittings shall receive a liberal coating of pipe thread compound immediately prior to assembly and the follower shall then be securely threaded onto the fitting without overtightening and damaging the threads.

In laying the copper tubing the Contractor shall ensure that the tubing is not subject to point loads due to any source,

kinking or crimping, cuts, scratches, or abrasions in excess of 10 percent of the tubing wall thickness. All tubing shall be cut using a cutter designed for cutting copper tubing. Damaged tubing shall be removed and replaced in accordance with the provisions of these Standard Specifications.

In approaching and leaving fittings and meters, the tubing shall not be bent in a curve with a radius tighter than 30 times the nominal diameter of the tubing. A straight run of tubing at least 10 times the nominal diameter shall be provided on each side of each fitting. A tubing bender shall be used to prevent crimping of the copper tubing.

Any damage to the fitting including but not limited to evidence of overtightening, misaligned threads, burring or scarring of machined faces, or any evidence of leakage shall be cause for rejection. If a leak is found to be caused by debris, the debris shall be cleared and the fitting visually inspected for damage before being charged. If the leak recurs upon charging of the line, the fitting shall be removed and replaced whether or not the cause can be determined.

When the total continuous length of tubing is less than 3 feet, the entire length shall be removed and replaced. When the total length of copper tubing exceeds 3 feet, the damaged fitting shall removed along with the preceding 6-inches (minimum) and replaced with a brass Grip Tite™, pack joint, or compression type coupling and replacement fitting and a length of Type "K" copper tubing.

Where copper tubing is to be connected to a dissimilar metal, a dielectric union shall be used to isolate the materials and prevent corrosion.

Section 302.04 Polyvinyl Chloride Service Piping (PVC)

Section 302.04.01 Materials - PVC service piping shall be Schedule 40 or Schedule 80 polyvinyl chloride (PVC) pipe conforming with the requirements of ASTM D1784 and D1785. Polyvinyl chloride service piping shall only be used as incidental material in the installation of above grade piping assemblies and the reconnection of customer plumbing to meters.

Fittings for PVC service piping shall conform to the following ASTM specifications:

1. Solvent Weld, Schedule 40 (Slip x Slip)..... ASTM D2466
2. Solvent Weld, Schedule 80 (Slip x Slip)..... ASTM D2467
3. Solvent Weld Iron Pipe Thread (Slip x IPT).....ASTM F437
4. Iron Pipe Thread ..... ASTM D2464

Cements for solvent weld pipe and fittings shall be in accordance with ASTM D2564. Primers for solvent weld pipe and fittings shall be in accordance with ASTM F656. The method of installation and assembly for solvent weld fittings and pipe shall be in accordance with ASTM D2855. The specific method of assembly, class of pipe, and fittings shall be as provided for in the *Contract Documents*. If conditions in the field vary from or are not provided for in the *Contract Documents*, the Contractor shall request direction from the Engineer prior to proceeding with the installation and assembly of PVC service piping.

Section 302.04.02 Construction - The Contractor shall assemble solvent weld fittings and pipe in accordance with the provisions of ASTM D2855 and these Standard Specifications. Pipe ends and the interior of fittings shall be cleaned of all loose and deleterious material and primed with solvent primer in accordance with the manufacturer's recommendations. A liberal coating of cement shall then be applied to both surfaces to be mated. The pipe shall be immediately inserted into the fitting or socket and rotated approximately 180 degrees to ensure complete and even coverage of the cement and surfaces. The joint shall be held for at least 30 seconds until the cement has taken its initial set and no movement of the joint occurs. The pipe shall not be charged before the minimum time recommended by the manufacturer of the cement. Any leaks discovered upon charging the line shall be repaired by removing the joint or fitting in question and replacing the entire assembly.

Threaded PVC fittings and pipe nipples shall be Schedule 80. In assembling threaded PVC pipe and fittings, the Contractor shall take care that the pipe is not scored in excess of 1/10th of the wall thickness. Threads of fittings

shall receive a liberal coating of pipe thread compound compatible with PVC pipe immediately prior to assembly and the pipe shall then be securely threaded onto the fitting without overtightening and damaging the threads.
Any damage to the pipe or fitting including but not limited to, evidence of overtightening, misaligned threads, burring or excessive scarring of pipe and fitting surfaces, or any evidence of leakage shall be cause for rejection. If a leak is found to be caused by debris, the debris shall be cleared and the assembly visually inspected for damage before being charged. If the leak recurs upon charging of the line, the fitting shall be removed and replaced whether or not the cause can be determined.

When the total continuous length of PVC service piping is less than 3 feet, the entire length shall be removed and replaced. When the total length of PVC service piping exceeds 3 feet, the damaged fitting shall removed along with the preceding 6-inches (minimum) and replaced with the appropriate type of coupling, PVC service piping, and a replacement fitting.

Section 302.05 Iron Service Piping

Section 302.05.01 Materials - Iron service piping shall be galvanized or black welded/seamless steel pipe conforming with the requirements of ASTM A53. All subsurface installations shall be galvanized pipe. Iron service piping shall only be used for appurtenances including but not limited to, blow-offs, backflow prevention assemblies, and in piping assemblies for facilities including but not limited to, pump stations, storage tanks, and treatment plants.

Fittings for iron service piping shall be threaded malleable iron welded/seamless type conforming with the requirements of ASTM A865. Fittings shall be either galvanized or black iron matching the pipe of the assembly.

Section 302.05.02 Construction - Pipe ends and the interior of fittings shall be cleaned of all loose and deleterious material. Pipe ends shall be mechanically threaded to match the threaded fittings in accordance with ASTM A865 and cleaned of all scale, shavings, cutting oil, and other deleterious material.

In assembling threaded iron pipe and fittings, the Contractor shall take care that the pipe is not scored in excess of 1/10th of the wall thickness by any means including but not limited to, spinning the pipe within tool jaws. Threads of fittings shall receive a liberal coating of pipe thread compound compatible with steel pipe immediately prior to assembly and the pipe shall then be securely threaded onto the fitting without overtightening and damaging the threads.

Galvanized iron pipe used as part of subsurface appurtenances shall be wrapped and coated with double lapped Protecto Tape or approved substitute.

Iron pipe connected to dissimilar metals shall be insulated against corrosion by the use of a die-electric union.

Any damage to the pipe or fitting including but not limited to evidence of overtightening, misaligned threads, burring or excessive scarring of pipe and fitting surfaces, or any evidence of leakage shall be cause for rejection. If a leak is found to be caused by debris, the debris shall be cleared and the assembly visually inspected for damage before being charged. If the leak recurs upon charging of the line, the fitting shall be removed and replaced whether or not the cause can be determined.

When the total continuous length of iron service piping is less than 3 feet, the entire length shall be removed and replaced. When the total length of iron service piping exceeds 3 feet, the damaged fitting shall removed along with the preceding 6-inches (minimum) and replaced with the appropriate type of coupling, iron pipe service piping, and a replacement fitting.

Section 302.06 Measurement - Normally, service line piping shall be paid for on an each basis for individual services to be installed or replaced.

When the *Contract Documents* provide for service line piping to be paid for by the linear foot, service line piping will be measured to the nearest foot.
Service line piping incidental to appurtenances, pumping facilities, and tanks shall be considered as incidental to and

included in the contract unit or lump sum price paid for other items of work and no additional compensation will be allowed therefor.

Section 302.07 Payment - The contract unit price per each for Install or Reconnect Residential Service and the contract unit price per linear foot for Install or Reconnect Residential Service shall include full compensation for furnishing all labor, tools, equipment, materials, and incidentals and for doing all work involved in installing or reconnecting residential service including but not limited to, service pipe material, fittings, inserts, excavation, bedding, backfill, pavement restoration, tapped connection to the distribution or transmission main, connection to the meter, reconnection of the customer plumbing, and flushing the customer plumbing complete in place as shown in the *Contract Documents*, as provided for in these Standard Specifications, and as directed by the Engineer and no additional compensation will be allowed therefor.

SECTION 303 FITTINGS

Section 303.01 Description - All fittings for transmission and distribution pipelines and piping assemblies shall be in accordance with this Section 303, "Fittings". Special fittings for non-standard applications shall be in accordance with the *Contract Documents*. For the purpose of this Section 303, fittings shall include but not be limited to, all tees, crosses, bends, reducers, flanges, make-up spools, repair couplings, sleeve-type couplings, transition couplings, tapping tees, flange coupling adapters, thrust restraining follower glands and harnesses, and flexible expansion joints. All fittings shall be rated for a minimum working pressure of 250-psi or that working pressure provided for in the *Contract Documents*.

Section 303.02 Ductile Iron Fittings

Section 303.02.01 Description - Except as provided for in the *Contract Documents*, all fittings on transmission and distribution pipelines and piping assemblies shall be manufactured of ductile iron in accordance with the provisions of AWWA C110 and C153. The interior of the fitting shall be cement-mortar lined in accordance with the provisions of AWWA C104. Mortar thickness shall be 1/16-inch for fittings up to 12-inches in diameter and 3/32-inch for fittings larger than 12-inches in diameter. The exterior shall be coated with an asphaltic coating approximately 0.001 inches thick. The asphaltic material shall be continuous and smooth, free of holes, blisters, or thick areas. The material shall remain pliable at temperatures below freezing and not sticky to the touch if stored in direct sunlight for any length of time.

The body of the fitting shall be free of blows, sand pits, abrasions deeper than 10 percent of the material thickness, cracks, and other defects that adversely affect the performance of the fitting under pressure in-situ or the corrosion potential of that fitting. Likewise the coatings shall be free of chips, holes, abrasions, and scratches that reduce the thickness of the coating below the tolerances specified herein.

Longitudinal contraction cracks in the cement-mortar lining less than the pipe diameter in length may be accepted if the Contractor can demonstrate that the crack will self-heal upon immersion in water. Minor abrasions and scratches in the asphaltic coating may be repaired by the use of a bitumastic coating, subject to the prior approval of the Engineer.

Evidence of such defects or damage shall be cause for rejection of the fitting and the Contractor shall replace such defective or damaged fittings at no cost to the District.

Section 303.02.02 Joints

Section 303.02.02(a) General - Joints on fittings used in subsurface installations of transmission and distribution pipelines shall be mechanical joint or flanged type, as provided for in the *Contract Documents*, conforming to the requirements of AWWA C111 and these Standard Specifications. In piping assemblies, both subsurface and above grade, the joints shall be either mechanical joint or flange type conforming with the requirements of AWWA C110, C111, and C153 as provided for in the *Contract Documents*.

Section 303.02.02(b) Mechanical Joints - Each mechanical joint shall be supplied with a vulcanized butadiene

rubber (SBR) gasket in accordance with the provisions of AWWA C111. The retainer or follower gland shall be replaced with a thrust restraining follower gland in accordance with the provisions of Section 304, "Thrust Restraint" of these Standard Specifications. Mechanical joint bolts (tee bolts) shall be 3/4-inches in diameter and be furnished for each joint in accordance with AWWA C110, AWWA C111, and AWWA C153. Bolt material shall be high-strength, low-alloy steel.

Section 303.02.02(c) Flanged Joints - Each flanged joint shall be supplied with a ring type, 1/8-inch thick vulcanized butadiene rubber (SBR) or neoprene rubber gasket conforming with the provisions of AWWA C110. Bolts and nuts shall be hex head in conformance with ASTM A307 and A563 in accordance with the provisions of AWWA C110. Bolts and nuts shall be fabricated of low carbon steel conforming with ASTM A307 galvanized after fabrication or stainless steel conforming with ASTM F593 and F594.

Section 303.02.03 Construction

Section 303.02.03(a) Mechanical Joints - Mechanical joints shall be installed in accordance with the manufacturer's recommendation and these Standard Specifications. The fitting shall be thoroughly cleaned of all dirt, debris, or other deleterious material and inspected prior to incorporation into the work.

The pipe end shall be beveled with a grinding tool or rasp file to facilitate the assembly of the joint. The restraining follower gland shall be slipped over the end of the pipe followed by the gasket. The Contractor shall take care that the restraining follower gland and gasket are installed in the correct alignment and that the gasket is not forced onto the pipe or otherwise damaged.

The pipe end shall then be inserted into the joint to the tolerance required by AWWA C110, C111, and C153. The pipe shall be aligned as straight as field conditions permit but in no case shall the pipe be deflected in excess of 3 degrees (5/8-inch per foot) or that maximum deflection recommended by the manufacturer, whichever is the lesser. The gasket shall then be inserted into the gasket seat taking care not to force or otherwise damage the gasket. Once the gasket is fully and evenly seated in the gasket space, the follower gland shall be aligned with the mating face of the fitting and the bolts inserted and the nuts threaded onto the bolts.

All bolting shall be performed in accordance with the provisions of Section 305, "Bolting Procedures" of these Standard Specifications.

Section 303.02.03(b) Flanged Joints - Flanged joints shall be installed in accordance with the manufacturer's recommendation and these Standard Specifications. The fitting shall be thoroughly cleaned of all dirt, debris, or other deleterious material and inspected prior to incorporation into the work.

The pipe and fitting shall be carefully aligned using slings, blocks, jacks, or other means necessary to establish and maintain the correct alignment. Under no circumstances shall the bolts be used to achieve the correct alignment. As the bolts are inserted through the flange the gasket shall be inserted between the mating faces of the fitting and pipe.

All bolting shall be performed in accordance with the provisions of Section 305, "Bolting Procedures" of these Standard Specifications.

Section 303.03 Welded Steel Fittings and Specials

Section 303.03.01 Description - Except as provided for in the *Contract Documents*, all fittings and specials on steel piping assemblies shall be manufactured of the same material and thickness as the pipe to which attached. All steel fittings and specials shall be seamless steel welding fittings in accordance with the provisions of AWWA C207, ASTM A284, and ASTM A285. Welded flanges shall be standard steel hub flanges in accordance with AWWA C207, Class"D".

Section 303.03.02 Coatings - All welded steel fittings shall be fusion bonded epoxy coated inside and out after fabrication in accordance with AWWA C213 after fabrication. The Contractor shall every take precaution including but not limited to, the use of fabric hoisting slings and protective wrappings, to protect the coating from damage

during transport and installation. Any damage found shall be immediately repaired in accordance with AWWA C213, Sections 3.4 and 3.5.

Evidence of such defects or damage shall be cause for rejection of the fitting and the Contractor shall replace such defective or damaged fittings at no cost to the District.

Section 303.03.03 Construction - All welded steel fittings and specials shall be fabricated in accordance with the provisions of AWWA C200 and these Standard Specifications.

All welders shall be certified in accordance with Sec. IX, part A, of the ASME Boiler and Pressure Vessel Code and AWS B2.1. A copy of the welder's current certification shall be submitted in accordance with Section 107.10, "Submittals" of these Standard Specifications. Insofar as practicable, all welding shall be performed by automatic welding machines in the fabricator's shop under controlled conditions. Field welding shall be kept to the minimum and subject to the prior approval of the Engineer.

All field welds that are permitted shall be immediately recoated in accordance with AWWA C213, Section 3.5.

Material to be welded shall be butted or lapped, as required, as closely as possible. The use of welding to bridge excessive gaps or misalignment will not be permitted and evidence thereof shall be cause for the rejection of the assembly.

Field erection of the piping assembly shall be performed in such a manner as to protect the assembly. Each flange joint shall be supplied with a ring type, 1/8-inch thick vulcanized butadiene rubber (SBR) or neoprene rubber gasket conforming with the provisions of AWWA C110. Bolts and nuts shall be hex head in conformance with ASTM A307 and A563 in accordance with the provisions of AWWA C110. Bolts and nuts shall be fabricated of low carbon steel conforming with ASTM A307 galvanized after fabrication or stainless steel conforming with ASTM F593 and F594. Flange bolts used in subsurface applications shall be stainless steel.

All bolting shall be performed in accordance with the provisions of Section 305, "Bolting Procedures" of these Standard Specifications.

Section 303.04 Flexible Expansion Couplings - Expansion couplings shall be installed at the locations provided for in the *Contract Documents* and at every pumping facility or storage tank. Expansion couplings shall be capable of simultaneous horizontal and vertical displacement up to a minimum of 15 degrees and a minimum longitudinal displacement of 4-inches. Expansion and deflection capability shall be designed as an integral part of the ductile iron ball or sleeve casting.

The coupling shall be either single or double ball or single sleeve type, as provided for in the *Contract Documents* manufactured of ductile iron and otherwise conforming with the provisions of AWWA C153. Internal surfaces shall be fusion bonded epoxy coated in accordance with AWWA C213. Exterior surfaces shall be either fusion bonded epoxy coated or asphaltic coating conforming with AWWA C153. Fitting ends shall be either flange or mechanical joint as provided for in the *Contract Documents* and installed in accordance with Section 303.02, "Ductile Iron Fittings" of these Standard Specifications.

The expansion coupling shall be Flex-Tend™ as manufactured EBAA Iron Sales, Inc., XTRA FLEX ™ as manufactured by U.S. Pipe & Foundary Company, or approved substitute.

Section 303.05 Bolted Couplings

Section 303.05.01 Description - For the purposes of this Section 303.05, bolted couplings shall include but not be limited to sleeve-type bolted couplings, compression type couplings, repair clamps, tapping tees, flange coupling adapters, and grooved coupling systems.

Section 303.05.02 Sleeve-Type Bolted Couplings - Sleeve-type bolted couplings, also known as "Dresser Couplings" and size transition couplings shall consist of a steel pipe sleeve conforming with the provisions of ASTM A53, 2 SBR rubber gaskets conforming with ASTM D2000, 2 ductile iron follower glands conforming with the

requirements of ASTM A536, and high-strength, low-alloy hexagonal steel bolts and nuts conforming with ASTM A325 and A563. Thrust restraint shall be in accordance with Section 304, "Thrust Restraint" of these Standard Specifications. Stud bolts will not be permitted.

Sleeve-type bolted couplings shall be Romac Style 511, Romac Style "TC400", Smith-Blair 400 Series, or approved substitute.

Section 303.05.03 Compression Couplings - Compression couplings shall consist of a galvanized steel sleeve conforming with AISI C1010-15, 2 NBR gaskets, and 2 galvanized malleable iron nuts conforming with ASTM A47.

Compression couplings shall be Romac Style 702, Smith-Blair 522, or approved substitute.

Section 303.05.04 Repair Couplings - Repair couplings shall be full circumference Type 304 stainless steel couplings with full contact SBR rubber gasket conforming with ASTM D2000, AISI Type 304 stainless steel, and ductile iron lugs conforming with ASTM A536. Repair couplings shall be so configured that the bolts and stainless steel band develop full contact pressure between the exterior pipe wall and the gasket. The gasket shall be textured to enhance contact against dirty and corroded surfaces of old pipe.

Repair couplings shall be Romac Stainless Seal™, Smith-Blair Full Circle® 200 Series clamp couplings or approved substitute.

Section 303.05.05 Tapping Sleeves - Tapping sleeves shall be split-case bolted stainless steel fittings specifically designed for tapping transmission and distribution pipelines under pressure. Multiple taps along the main shall be spaced a minimum of 5-feet apart.

Tapping sleeves shall be full circumference Type 304 stainless steel couplings with full contact SBR rubber gasket conforming with ASTM D2000, and heavy gauge AISI Type 304 stainless steel. Tapping sleeves shall be so configured that the bolts and stainless steel band develop full contact pressure between the exterior pipe wall and the gasket. The gasket shall be textured to enhance contact against dirty and corroded surf aces of old pipe.

The outlet flange shall be a standard flange conforming with AWWA C207, Class "D" or AWWA C110 for 250-psi working pressure (ANSI B16.1, Class 125). The length of the nozzle shall be sufficient to accommodate standard tapping valves and machines. The nozzle shall also be provided with a standard ¾-inch NPT test plug of Type 304 stainless steel. Upon installation of the tapping tee and prior to commencing the tapping operation, the tapping sleeve shall be tested by connecting an air source to the plug, closing the tapping valve, and applying compressed air to the assembly. The test pressure shall be equivalent to the test pressure of the line being connected. The test pressure shall be held for a minimum of 5-minutes and monitored with a gauge on the test plug assembly.

Tapping sleeves shall be Romac SST® Stainless Steel Tapping Sleeves, Smith-Blair 662-663 Series tapping sleeves, or approved substitute.

Section 303.05.06 Flange-Coupling Adapters and Make-Up Spools - Flange-Coupling Adapters shall have a thrust restraining capability when used with metallic or PVC pipe. The restraint mechanism shall consist of multiple, individually activated gripping surfaces. The follower gland shall be manufactured of ductile iron conforming with ASTM A536. The follower gland shall be sized in accordance with AWWA C110, C111, and C153 to be compatible with standard mechanical joint fittings. Tee bolts shall be in accordance with said AWWA specifications.

The gripping surfaces shall activate by a wedging action. Each restraining device shall be equipped with a twist-off nut of the same size as the tee bolts. The head of the nut shall be capable of shearing when the applied torque exceeds the specified torque for the particular size fitting. The flange-coupling adapter shall be Megalug® Series 2100 Megaflange-Flange Adapter manufactured by EBAA IRON SALES, INC. or approved substitute. Flange-couplings adapters for use with asbestos cement pipe shall be Smith-Blair Series 916 or approved substitute.

Make-Up Spools for transmission and distribution pipelines shall be short body ductile iron sleeves otherwise conforming with the requirements of Section 303.02, "Ductile Iron Fittings" of these Standard Specifications. The mechanical joint follower gland shall be replaced with a ductile iron restraining follower gland in accordance with Section 304, "Thrust Restraint" of these Standard Specifications.

Section 303.05.07 Grooved Fittings - Where provided for in the *Contract Documents*, fittings in piping assemblies shall be grooved-type ductile or malleable iron fittings. Such grooved fittings shall attain watertightness by the use of a full circumference gasket confined and compressed within the coupling housing.

Housings shall be either malleable iron conforming with ASTM A47 or ductile iron conforming with ASTM A536. Bolts shall be carbon steel in accordance with ASTM A183. Gaskets shall be Grade 3B in accordance with ASTM D2000.

Grooved fittings shall be furnished and installed as provided for in AWWA C606 and as manufactured by Victaulic Company of America or approved substitute.

SECTION 304 THRUST RESTRAINT

Section 304.01 Description - All pipelines and piping assemblies shall be restrained against the hydrostatic and hydrodynamic forces inherent within public potable water supply and distribution systems. Thrust restraint shall be accomplished by the use of mechanically restrained joints, restraint harness, or cast-in-place portland cement concrete thrust blocks. Grooved, welded, and flanged fittings shall be considered as thrust restrained fittings.

Section 304.02 Mechanically Restrained Joints - All mechanical joint fittings and pipe shall have the follower gland replaced with a thrust restraining follower gland assembly. The restraint mechanism shall consist of multiple, individually activated gripping surfaces or a continuous, split- ring type of gripping surface. The restraining follower gland shall be manufactured of ductile iron conforming with ASTM A536. The follower gland shall be sized in accordance with AWWA C110, C111, and C153 to be compatible with standard mechanical joint fittings. Tee bolts shall be in accordance with said AWWA specifications. Only one type of restraining assembly will be permitted on any project.

Restraint mechanisms consisting of multiple gripping surfaces shall activate by a wedging action of the individual gripping surfaces. Each restraining device shall be equipped with a twist-off nut of the same size as the tee bolts. The head of the nut shall be capable of shearing when the applied torque exceeds the specified torque for the particular size fitting. The mechanical restraining follower gland shall be Megalug® Series 1100, Series 1100SD, Series 1100PV, or Series 2000PV as manufactured by EBAA IRON SALES, INC. or approved substitute.

Restraint mechanisms consisting of a single, split-ring type restrainer shall activate by a wedging action of the grip ring as a unit. This wedging action shall be initiated by the installation of a mechanical joint follower gland specifically designed for the split-ring restainer and shall apply a uniform force throughout the length of the split-ring. The split-ring shall be manufactured of ductile iron conforming with ASTM A536. Split-ring type restrainers shall be GripRing™ as manufactured by Romac Industries, Inc. or approved substitute.
Each fitting shall be restrained in accordance with the recommendations of the publications "Thrust Restraint Design for Ductile Iron Pipe", 2nd Edition-1986 by the Ductile Iron Pipe Association and "PVC Pipe Thrust Restraint Design Handbook" by EBAA IRON, INC..

As a minimum, the Contractor shall install 40 linear feet of restrained pipe on each side of a restrained fitting or joint. At the Contractor's option and subject to the approval of the Engineer, thrust restraint at tie-ins to existing pipelines may be restrained by the use of portland cement concrete thrust blocks in accordance with Section 304.04, Portland Cement Concrete Thrust Blocks" of these Standard Specifications. This option shall only be in lieu of removing and replacing 40 linear feet of asbestos cement pipe with restrained pipe on each side of the tie-in.

This restraint for ductile iron pipe shall be accomplished by replacing the standard push-on gasket with a restraining type gasket (FIELD LOK®) in accordance with Section 301.03, "Ductile Iron Pipe" of these Standard Specifications.

For PVC pipe, the restraint shall be accomplished by the use of a restraint harness bridging the push-on bell. This harness shall be so designed as to prevent the harness bolts from contacting the outside of the bell. The harness shall be Megalug® Series 1500 by EBAA IRON SALES, INC., UNI-FLANGE Series 1390, or approved substitute.

Section 304.03 Steel Pipe with Bolted Couplings - Joints and fittings for steel pie that utilize bolted couplings in accordance with Section 303.05, "Bolted Couplings" of these Standard Specifications shall be restrained by the use of restraint harnesses welded to the pipe wall on each side of the bolted coupling. The harness shall be fabricated of the same material as the pipe and welded to the pipe during fabrication and before coating. A tie-rod of high-strength, low-alloy hexagonal bolt or threaded rod and nut conforming with ASTM A365 and A563 shall connect each pair of restraint harnesses. The Contractor shall provide copies of structural calculations and plans prepared by an engineer registered to practice in the State of California for the design of such restraint harnesses.

The Contractor shall take care in the installation of piping assemblies to protect the coating of the pipe. The tie-rods shall be coated after installation with a bitumastic type coating (Protecto Wrap 160/160H, Tapecoat Brush-Applied Coating, or approved substitute).

Section 304.04 Portland Cement Concrete Thrust Blocks - Where provided for in these Standard Specifications and the *Contract Documents*, the Contractor shall construct portland cement concrete thrust blocks to restrain hydraulic forces. Thrust blocks shall be in accordance with Standard Plan S-7, "Thrust Block Details" of these Standard Specifications and this Section 304.04.

Normally, portland cement concrete thrust blocks shall only be permitted to restrain fittings on existing pipelines. The Contractor shall not pressurize the main until the thust block has achieved a minimum of _ of the 28-day compressive strength or 7-days, whichever is the earliest. Where the main must be pressurized prior to that time, the Contractor shall provide temporary thrust restraint using timbers in a manner approved by the Engineer. Such temporary restraint shall not be removed from the excavation nor shall the temporary restraint interfere in any way with the permanent thrust block.

All concrete for thrust blocks shall be Class "B" concrete in accordance with Section 308, "Concrete Structures" of these Standard Specifications. The Contractor shall excavate the soil surrounding the thrust block with a minimum of unnecessary disturbance to the soil left in-place. If deemed necessary by the Engineer, the Contractor shall hand excavate the bearing surfaces to ensure full contact with undisturbed material.

Restraining rods and tie-rods shall be coated with a bitumastic type coating (Protecto Wrap 160/160H, Tapecoat Brush-Applied Coating, or approved substitute) prior to placement in the excavation. Such wrapping shall extend a minimum of 2-inches and a maximum of 4-inches into the concrete. Total embedment shall be a minimum of 18-inches. All bends shall have a minimum radius of 20 diameters. Heating shall not be used in bending bars and tie-rods. The radius shall be such that a minimum of 8-inches of straight stock is embedded in the concrete prior to commencing the bend. Evidence of heating, embrittlement, cracking, deformation, or other damage detrimental to the strength of the material shall be cause for rejection by the Engineer and the Contractor shall remove and replace such deficient material prior to pouring the thrust block at his expense.

All surfaces of fittings and pipe and all bolts and threaded rods shall be thoroughly coated with a bitumastic type sealant in accordance with Section 305, "Bolting Procedures" of these Standard Specifications.

The flanges, bells, follower glands, and bolts of all fittings shall be protected from contact with concrete during pouring. As required by field conditions, the Contractor shall wrap the joint portion of fittings with a stiff material such as roofing felt or install forms to confine the concrete to the plane of the proposed thrust block. The goal of this requirement is to enable the readjustment or removal of all bolts and plugs and the removal of the fitting at a later date without necessitating the removal of the thrust block first.

Section 304.05 Measurement and Payment - Except as provided for in the *Contract Documents*, thrust restraint shall be considered as incidental to other items of work and all costs shall be included in the contract unit or lump sum prices for other items of work and no additional compensation will be allowed therefor.

SECTION 305 BOLTING PROCEDURES

Section 305.01 Description - All fittings, joints, assemblies, valves, and miscellaneous special fittings shall be installed in accordance with this Section 305. The required torque shall be as specified in these Standard Specifications, the *Contract Documents*, the referenced specifications, and the manufacturer's recommendations.

Section 305.02 Procedure - The pipe and fitting (or fittings) shall be carefully aligned using slings, blocks, jacks, or other means necessary to establish and maintain the correct alignment. Under no circumstances shall the bolts be used to achieve the correct alignment. As the bolts are inserted through the flange the gasket shall be inserted between the mating faces of the fitting and pipe.

After taking up the free slack in the nuts, the Contractor shall tighten each bolt in opposing succession taking multiple passes to achieve the proper. Opposing succession is hereby defined as tightening the first nut then the nut diametrically opposed to the first and proceeding either clockwise or counterclockwise in this manner around the circumference of the joint until the required torque is achieved. In no case shall the Contractor tighten the nuts in direct sequence or overtighten any nut with respect to its opposing mate.

During the tightening operation and again upon completion of the tightening operation, the space between the mating faces of the fitting and pipe shall be inspected for evidence of non-parallel assembly. The tolerance for parallel assembly shall be 1/16-inches for mechanical joint faces and 1/32-inches for flanged faces. Other fittings and faces shall be within the tolerance recommended by the manufacturer. If the space is non-parallel in excess of such tolerance, the joint shall be completely disassembled and the installation repeated. The gasket shall be inspected for damage prior to retightening the bolts. If the mating faces of the fitting and pipe cannot be brought into parallel alignment the joint shall be disassembled, the pipe removed, the gasket replaced, and the assembly repeated.

Upon completion of the bolting operation between elements of the fittings and joints, the Contractor shall tighten all thrust restraint gripping surf aces in the same manner of opposing succession. The thrust restraining follower gland shall be tightened to the recommended torque as recommended by the manufacturer. The twist-off nut shall be considered as a safety mechanism to prevent damage from excessive torsional forces. The shear capability shall not be used in lieu of proper tightening, including the use of limiting torque wrenches.

All bolts on the fittings or joint, including those of the thrust restraining devices, shall be subject to a torque test by the Engineer. If any bolts are found to be under- or over-torqued or in any way evidencing damage, the Engineer may direct their readjustment or replacement in accordance with the provisions of this Section 305.

Upon completion of the bolting operation, all buried fittings shall receive a liberal coating of bitumastic type material (Protecto Wrap 160/160H, Tapecoat Brush-Applied Coating, or approved substitute). This coating shall be thoroughly worked into the spaces between joint faces, under and around bolts and nuts, and on all surfaces that will be in soil contact. The coating shall be allowed to attain an initial set prior to commencing any backfill operations and in no case shall backfill operations commence less then 1-hour after coating is completed.

SECTION 306 CASING AND DUCT INSTALLATIONS

Section 306.01 Description - Where provided for in the *Contract Documents*, the Contractor shall install the water main or service piping within a steel casing or other ducting. Such installations shall include but not be limited to, freeway crossings, railway crossings, stream crossings, installations adjacent to structures, and service piping related to other facilities such as pumping and treatment plants. The water main or service piping shall be known as the carrier pipe for the purposes of this Section 306.

Section 306.02 Bore and Jack Installations

Section 306.02.01 General - Where provided for in the *Contract Documents*, the Contractor shall install a casing by the boring and jacking method and insert the carrier pipe therein. The casing shall be welded steel pipe conforming with the provisions of Section 301.04, "Welded Steel Pipe" of these Standard Specifications. Casing for

jacking installation shall not be coated except as provided for in the *Contract Documents*.

Section 306.02.02 Pipe Thickness Design for Casings - The thickness of the pipe provided for in the *Contract Documents* shall be considered the minimum required thickness. The actual pipe wall thickness installed shall be that thickness necessary to withstand the jacking forces imposed by the jacking machine or that provided for in the *Contract Documents*, whichever is the greater. The Contractor shall bear full responsibility for the selection of the pipe wall thickness as provided for herein.

Section 306.02.03 Jacking Machines - The Contractor shall excavate jacking and receiving pits where shown on in the *Contract Documents*. Such excavations shall be shored as necessary in accordance with the provisions of the State Industrial Safety Orders and the Safety Plan provided for in Section 104.08, "Industrial Safety Orders", and Section 107.10, "Submittals" of these Standard Specifications. The jacking pit shall be the minimum necessary to accommodate the jacking machinery. The jacking machine shall be of the hydraulically operated ram type with guide rails for the casing and boring tool. The jacking machine shall have a bearing plate of sufficient surface area to resist the forces applied, assuming a soil bearing pressure of 2,500 pounds per square foot or that value provided for in the *Contract Documents*. The receiving pit shall not be excavated any sooner than necessary to prevent delays in the jacking operation.

The Engineer will provide the first set of construction staking for the jacking and receiving pits and the alignment control of the boring operation. The Contractor shall provide the Engineer with all requirements for surveying unique to the machine and equipment used in accordance with Section 107.10, "Submittals" of these Standard Specifications.

The jacking machine operator shall have the ability to monitor the jacking operation for displacements from the designed line and grade. The tolerance for alignment shall be one percent from the theoretical alignment. The Contractor may use welded wedges or deformed coupons along the length of the casing to guide the alignment.

Section 306.02.04 Survey Grid for Jacked Casings - Where provided for in the *Contract Documents*, the Contractor shall have a control grid of the surface over the centerline of the casing prepared by a surveyor or civil engineer registered in the State of California. The grid shall consist of points located on 5-foot centers along and 5-feet each side of the proposed alignment and a set of points 10-feet on center along and on each side of the 5-foot grid to a distance of 25-feet offset to the proposed centerline. These points shall be so marked as to be recoverable throughout the life of the project. The horizontal and vertical location of each of these points shall be determined no more than 5 working days prior to commencing boring and jacking operations. Upon completion of 2 working days following completion of boring operations, the grid will be resurveyed and the 2 sets of data compared.

Section 306.02.05 Tolerance for Jacked Casings - The actual bored diameter of the excavation shall be not more than 0.1 feet larger than the outside diameter of the casing. The Contractor may be required to demonstrate conformance with this requirement. If so required, the Contractor shall stockpile all spoils in a safe manner adjacent to the excavation for the Engineer to measure. Except as provided for in the *Contract Documents*, a bulking factor of 150 percent shall be applied to determine the actual volume excavated. This volume will be compared with that volume calculated from the outside diameter of the casing. If the difference in volume is excessive, as defined herein, the Contractor shall make provisions for and inject a cementitious grout throughout the length of the annular space outside the casing. The quantities of grout shall be carefully measured during the injection process. The Contractor shall immediately stop injection upon reaching the volume difference calculated herein or upon evidence of any displacement of the surrounding soil structure.

Each point of the survey grid provided for in Section 306.02.04, "Survey Grid" of these Standard Specifications shall be considered as undisturbed if the difference in elevation between the surveys is less than 0.02 feet.

If, in the opinion of the Engineer or the owner of the right-of-way crossed, the displacement of the surface so surveyed is deemed excessive, the Contractor shall determine the cause thereof and provide remedial action to the satisfaction of such owner. Due to the nature of such work, the actual manner and extent of remediation can only be determined at the time of occurrence. Normally, this will include but not be limited to such work as injection grouting, pavement grinding, crack sealing, removal and replacement of damaged surface materials, and

reconstruction of slopes adjacent to the roadway.

If the final alignment varies in excess of that tolerance provided for, the District may charge damages in the amounts provided for in the *Contract Documents*. In no case will the amount charged the Contractor be less than the actual costs incurred by the District including but not limited to, penalties, legal fees, engineering, inspection, right-of-way acquisition, and administration. If, in the opinion of the Engineer, the installation is excessively out of tolerance and poses any hazard to the public safety or encroaches upon and encumbers property to which the District has no legal access, the Contractor may be required to reconstruct the installation where directed by the Engineer. The original installation shall be abandoned in place after filling with a sand slurry and capping the ends. If the original installation poses a hazard to public safety, the Contractor may be required to remove the casing and restore the site to a safe condition. All costs associated with such remedial work shall be borne by the Contractor.

Section 306.03 Cut and Cover Installations

Section 306.03.01 General - In locations provided for in the *Contract Documents* including but not limited to close proximity to structures, shallow installations, and those locations required by other agencies, the Contractor shall install casings to protect the water main and the structures. The *Contract Documents* may also provide for the installation of duct runs for the installation of electrical conduit, chemical feed lines, fuel lines, and irrigation piping.

Section 306.03.02 Materials

Section 306.03.02(a) Steel Casings - Steel casings for cut and cover installations shall be in accordance with Section 301.04, "Welded Steel Pipe" of these Standard Specifications. Such steel casings shall be coated inside and out in accordance with Section 301.04.04, "Coatings" of these Standard Specifications. Alternatively, as provided for in the *Contract Documents*, the casing may be coated with a coal-tar coating and lining in accordance with AWWA C203. Field welding of joints shall be in accordance with Section 301.05, "Construction, Fabrication, and Installation" of these Standard Specifications.

Section 306.03.02(b) Non-Metallic Ducting - Non-metallic ducting may be used to construct service ducts for service piping, fuel lines, chemical feed lines, and electrical conduits. The purpose of such ducts is to provide ready access for the installation and replacement of such lines and conduits without excavation at a later date.

Unless otherwise provided for in the *Contract Documents*, all non-metallic ducting shall be Schedule 125 PVC irrigation pipe conforming with ASTM D2241 and D1784, Schedule 40 PVC electrical conduit conforming with UL 651, or smooth wall corrugated or rigid polyethylene drainage pipe conforming with ASTM F405 or F810.

Section 306.03.03 Construction - The Contractor shall excavate a trench for the casing that is no less than 12-inches wider than the nominal diameter of the casing nor more than 24-inches wider than the nominal diameter of the casing. The casing or duct shall be laid to grade in the trench such that no discernible change in grade occurs across any joint or in any length of nonmetallic ducting.

The trench shall then be backfilled in accordance with Section 309, "Bedding, Backfill, and Aggregate Bases" of these Standard Specifications and the provisions of the *Contract Documents*.

Section 306.04 Carrier Pipe Installation - Upon completion of the casing installation the Contractor shall install the carrier pipe in the casing or duct in accordance with this Section 306.04.

The Contractor shall attach heavy-duty insulators to the barrel of transmission and distribution pipelines in advance of inserting the pipe into the casing. The insulators shall consist of a full-circumference steel band (minimum 14 ga.) with a rust resisting coating. Except as provided for in the *Contract Documents*, bearing skids may be eliminated from the top half of the insulator band. All bolts shall be 5/16-inch diameter cadmium plated hex head bolt and nut. The insulator shall be lined with a PVC insulating liner. The bearing skids shall be heavy duty PVC material chamfered on both ends to facilitate passage through the pipe.

Pipe skid insulators shall be Calpico Model M Series or approved substitute.

An insulator shall be attached to the barrel of each length of pipe within 1-foot of each joint to ensure that each length of pipe is fully supported by the insulators. An additional insulator shall be installed at mid-span on PVC pipe. After the insulators are in place the Contractor shall push or pull the pipe through the casing at a rate that will prevent the pipe from riding up on the wall of the casing and overturning. The Contractor shall use blocks or bars across the surface of the pipe end bearing the load of the installation. Insofar as practicable, the pipe shall extend past both ends of the casing at least 10-feet before the first exposed joint.

Where provided for in the *Contract Documents* the Contractor shall seal the annular space between the casing and the carrier pipe with mechanical rubber seal to form a watertight seal capable of withstanding a 20-psi internal pressure. Such seals shall be Calpico Pipe Linx®, Model CSL Linx or approved substitute. When an annular seal is provided for, the insulators shall be of the centering style.

After the carrier pipe is fully installed the Contractor shall install a pull-on end seal with a minimum of 2 stainless steel band clamps on each end of the casing. End seals shall be Calpico Model C or approved substitute.

The Contractor shall install carrier piping in non-metallic ducting by inserting the pipe through the duct. No insulators will be required unless provided for in the *Contract Documents*. The end of the duct, when fully buried shall be sealed with an end seal as provided for herein and all voids in the seal shall be sealed with a liberal injection of a silicon caulk.

Section 306.05 Measurement - Quantities of casing installation will be measured by the linear foot to the nearest 2 foot increment or portion thereof along the centerline of the pipeline as constructed. Except as provided for in the *Contract Documents*, all pipelines, fittings, and thrust restraint systems installed as part of such casing installation will be paid for under the contract unit or lump sum price for pipelines or other items of work and no additional compensation will be allowed therefor.

Section 306.06 Payment - The contract unit price per linear foot for "Install Casing" or "Install Duct" shall include full compensation for furnishing all labor, tools, equipment, materials, and incidentals and for doing all work involved in installing casings and ducts including but not limited to excavation, boring, jacking, casing, welding, ducting, installing carrier pipe, insulators, seals, bedding, and backfill complete in place as shown in the *Contract Documents*, as provided for in these Standard Specifications, and as directed by the Engineer and no additional compensation will be allowed therefor.

SECTION 307 VALVES AND HYDRANTS

Section 307.01 Description - Valves shall be defined as all mechanisms used for controlling the flow of potable water from a transmission or distribution pipeline to the point of use. Valves shall include but not be limited to, gate valves, butterfly valves, ball valves, blow-off valves, air/vacuum release valves, check valves, pressure reducing or sustaining valves, pump control valves, surge control valves, solenoid activated valves, pneumatically activated valves, reduced pressure valves, rate of flow control valves, and altitude valves.

Section 307.02 Gate Valves

Section 307.02.01 Description - Gate valves shall be used for all pipeline and piping assemblies smaller than 10-inches in diameter. Such gate valves shall be iron body, bronze mounted, resilient seat type with non-rising stem, conforming with AWWA C509 and these Standard Specifications. Except as provided for in the *Contract Documents*, the Contractor shall only use the product of one manufacturer throughout the life of the project.

Section 307.02.02 Pressure Rating - Except as provided for in the *Contract Documents*, all gate valves shall be rated for zero-leakage (drip-tight) closure at 200 psi water working pressure. Additionally, each valve shall be hydrostatically tested at 400 psi for structural soundness. Testing for conformance to these specifications shall be in accordance with AWWA C509.

Section 307.02.03 Ends - As called for in the *Contract Documents*, valve ends shall be mechanical joint, flange, or

combination flange by mechanical joint. Such joints shall be in accordance with Section 303.02, "Ductile Iron Fittings" of these Standard Specifications. Gate valves 2-inch and smaller shall be threaded.

Section 307.02.04 Materials - All materials used in the manufacture of gate valves shall be in accordance with the following mechanical schedule:

MECHANICAL SCHEDULE - RESILIENT SEAT GATE VALVES		
DESCRIPTION	**MATERIAL**	**MATERIAL STANDARD**
Bonnet bolts and nuts	Stainless Steel	Type 304
Test plug	Iron	
Retainer nut for wrench nut	Stainless Steel	Type 304
Stuffing box gasket	Composition or Rubber	ASTM D1170 or D2000
Wrench nut	Cast iron	ASTM A126, Class B
Stuffing box bolt and nut	Stainless Steel	Type 304
Stem	Bronze	ASTM B138
Hand wheel	Cast iron	ASTM A126, Class B
Stuffing box and stem O-ring	Rubber	ASTM D2000
Stuffing box	Cast iron	ASTM A126, Class B
Disc	Cast iron	ASTM A126, Class B
Seat Ring	Rubber	ASTM D2000
Retaining screw	Stainless steel	Type 304
Bonnet	Cast iron	ASTM A126, Class B
Bonnet gasket	Composition or rubber	ASTM D1170 or D2000
Body	Cast iron	ASTM A126, Class B

Section 307.02.05 Coatings - The interior of the valve body, bonnet, and seal shall be fusion-bonded epoxy coated to a minimum thickness of 0.005-inches in accordance with AWWA C550. The exterior shall be either epoxy coated in accordance with AWWA C550 or coated with an asphaltic varnish in accordance with AWWA C110, Section 10-9.1, "Outside coating".

Section 307.02.06 Markings - Each valve body shall be marked during the casting process with the name of the manufacturer, year of manufacture, maximum working pressure, and valve size. The operating nut wing and the handwheel shall be stamped with an arrow and the word **OPEN** to indicate the direction of opening.

Section 307.02.07 Design and Operation - All gate valves shall be non-rising stem, counter-clockwise opening. The valve shall be capable of operation in any position other than horizontal with full rated pressure in either direction. Thrust collars shall be a machined portion of the basic stock from which the stem is machined. A thrust bearing shall be incorporated into the stuffing box assembly. This thrust bearing shall be Type 304 stainless steel, Nylon 101 conforming with Federal Specification Nº. L-P-401A, or other low friction, non-corrosive material to optimize operating torques. The valves shall be furnished with 2 O-ring stem seals in the stuffing box above the

thrust bearing and one below the thrust bearing. Each O-ring seal shall be set in a recessed groove machined into the stem shaft. This groove shall not be less than the root diameter of the stem threads.

The stuffing box and bonnet gaskets shall be either a full face flat composition type or an O-ring type set in a machined groove on both mating surfaces. The groove shall be so sized that the O-ring is compressed to fill the groove when the stuffing box and bonnet bolts and nuts are torqued to the manufacturer's recommendation.

The disc shall be either fully encapsulated in Buna rubber conforming with ASTM D2000 or furnished with a field replaceable seat ring of steel reinforced rubber secured by self-locking stainless steel screws. The disc shall be guided by integral lugs and guides in a tongue and groove manner throughout the range of travel.

The valve shall be so designed as to be serviceable without removal from the installation. The stuffing box shall be removable while the valve is under pressure in either the open or closed position. The bonnet and all internal components shall be removable with the valve in-situ.

Section 307.02.08 Warranty - Each gate valve shall be furnished with a manufacturer's 10-year limited warranty against defects in materials and workmanship. Such warranty shall transfer to the District upon final acceptance of the improvements.

Section 307.02.09 Representative Models - Gate valves shall be Mueller Super-Seal, Kennedy Ken-Seal™ II, M & H Style 3607 or Style 2500, Waterous "Series 500", or approved substitute.

Section 307.02.10 Construction and Installation - Each gate valve shall be installed in the locations and orientation provided for in the *Contract Documents*. Jointing to pipelines, fittings and other valves shall be in accordance with the provisions of Sections 303.02.03(a), "Mechanical Joints" and 303.02.03(b), "Flanged Joints" of these Standard Specifications.

Direct buried valves larger than 2-inch shall be supported by a block directly under the valve body. Such blocks shall be either redwood or pressure treated timber at least a nominal 4-inches in each dimension and 12-inches long. At the Contractor's option and subject to the Engineer's approval, other blocking materials, such as pier blocks, may be used. The valve shall be fully coated in accordance with Section 305, "Bolting Procedures" of these Standard Specifications. A valve box shall be installed over each valve in accordance with Section 308, "Concrete Structures" of these Standard Specifications.

Valves included in piping assemblies above grade or underground within vaults, shall be supported by the use of pipe supports. Pipe supports shall be installed on a concrete pad of at least 4-inch thickness and 18-inches square. Pipe supports shall be Grinnell Figure 264, Standon Pipe Support Model S-89, or approved substitute.

Section 307.02.11 Testing and Acceptance - All gate valves shall be inspected by the Engineer prior to installation. Upon installation, each valve shall be operated under no pressure prior to charging the line to verify free travel without interference. Upon charging the pipeline, each valve shall be included in the hydrostatic test as provided for in Section 301.05.07, "Hydrostatic Testing" of these Standard Specifications. Upon satisfactory completion of all work, each gate valve shall be operated under load to verify acceptable operation in accordance with the provisions of this Section 307.02. The Contractor shall bear full responsibility for the inspection, evaluation, removal, and replacement of defective gate valves as provided for in these Standard Specifications.

Section 307.02.12 Measurement and Payment

Section 307.02.12(a) Unit Basis - When gate valves are provided for in the *Contract Documents* to be paid for as a unit, the contract unit price per each shall include full compensation for all labor, materials, equipment, and tools and for doing all work in installing gate valves including but not limited to, excavation, bedding, supports, providing the valve, connection to the pipeline or fitting, valve box, backfill, and pavement repair, complete in place as provided for in the *Contract Documents*, as provided for in these Standard Specifications, and as directed by the Engineer and no additional compensation will be allowed therefor.

Section 307.02.12(b) Incidental Basis - When a pay item for gate valves is not included in the *Contract Documents*, all costs for such gate valves as are provided for in the *Contract Documents* shall be considered as incidental to other items of work and all costs associated with such gate valves shall be included in the contract unit or lump sum prices for other items of work and no additional compensation allowed therefor.

Section 307.03 Butterfly Valves

Section 307.03.01 Description - Butterfly valves shall be used for all pipeline and piping assemblies 10-inches in diameter and larger. Such butterfly valves shall be iron body, rubber-seated geared type with traveling nut type stem, conforming with AWWA C504 and these Standard Specifications. Except as provided for in the *Contract Documents*, the Contractor shall only use the product of one manufacturer throughout the life of the project.

Section 307.03.02 Pressure Rating - Except as provided for in the *Contract Documents*, all butterfly valves shall be rated for zero-leakage (drip-tight) closure at 150 psi steady-state working pressure, 150 psi differential pressure, and a maximum velocity of 16 fps. Testing for conformance to these specifications shall be in accordance with AWWA C504.

Section 307.03.03 Ends - As called for in the *Contract Documents*, valve ends shall be mechanical joint, flange, combination flange by mechanical joint, or wafer type. Such joints shall be in accordance with Section 303.02, "Ductile Iron Fittings" of these Standard Specifications. The body may be either short body or long body style. The Contractor shall provide verification from the manufacturer that the length of the body is sufficient for the disc to rotate fully when used with the pipe provided for in the *Contract Documents*.

Section 307.03.04 Materials - All materials used in the manufacture of butterfly valves shall be in accordance with the following mechanical schedule:

MECHANICAL SCHEDULE - RUBBER-SEATED BUTTERFLY VALVES

DESCRIPTION	MATERIAL	MATERIAL STANDARD
Operator cover bolts and nuts	Stainless Steel	Type 304
Retainer nut for wrench nut	Stainless Steel	Type 304
Operator cover gasket	Composition or Rubber	ASTM D1170 or D2000
Wrench nut	Cast iron	ASTM A126, Class B
Operator to body bolts and nuts	Stainless Steel	Type 304
Stem	Stainless steel	Type 304
Hand wheel	Cast iron	ASTM A126, Class B
Shaft seal	Rubber O-ring	ASTM D2000
Operator enclosure	Cast iron	ASTM A126, Class B
Disc	Cast iron	ASTM A126, Class B
Seat Ring	Rubber	ASTM D2000
Retaining screw	Stainless steel	Type 304
Body	Cast iron	ASTM A126, Class B or ASTM A48, Class 40 (Wafer Style)

Section 307.03.05 Coatings - The interior of the valve body, bonnet, and seal shall be fusion-bonded epoxy coated to a minimum thickness of 0.005-inches in accordance with AWWA C550. The exterior shall be either epoxy coated in accordance with AWWA C550 or coated with an asphaltic varnish in accordance with AWWA C110, Section 10-9.1, "Outside coating".

Section 307.03.06 Markings - Each valve body shall be marked during the casting process with the name of the manufacturer, year of manufacture, maximum working pressure, and valve size. The operating nut wing and the handwheel shall be stamped with an arrow and the word **OPEN** to indicate the direction of opening.

Section 307.03.07 Design and Operation - All butterfly valves shall be traveling nut type designed to withstand 300 foot-pounds of input torque at full open or full closed positions without damage to the valve or operator and counter-clockwise opening. The valve shall be capable of operation in any position other than horizontal with full rated pressure in either direction. The valve operator housing shall be fully gasketed, grease packed, designed for submersion in water to 10 psi (23.1 feet), and direct burial. The valve shall close with 20 to 40 turns, dependent upon size and manufacturer.

The operator body to valve body gaskets shall be either a full face flat composition type or an O-ring type set in a machined groove on both mating surfaces. The groove shall be so sized that the O-ring is compressed to fill the groove when the operator body bolts and nuts are torqued to the manufacturer's recommendation.

The disc may be furnished with a field replaceable seat ring of steel reinforced rubber secured by self-locking stainless steel screws. If so supplied, the disc shall seat against a machined seat within the valve body. If the disc of the valve furnished is not provided with a seat ring, a rubber body seat shall be set into a groove in the valve body. The rubber seat shall be so secured as to remain tight and drip free throughout the range of travel at full rated pressure.

The valve shall be so designed as to be serviceable without removal from the installation. The operator housing shall be removable while the valve is under pressure in either the open or closed position. The stem, disc, and all internal components shall be removable with the valve in-situ.

Section 307.03.08 Pneumatic Actuator - Where provided for in the *Contract Documents*, butterfly valves shall be equipped with pneumatic operators for automatic or combination manual/automatic control of valve operations. The actuator shall be capable of moving the valve from any position to full open or fully closed upon application of air pressure. The actuator shall be speed controlled to match the minimum closing times required for the application to prevent excessive surge pressures.

Section 307.03.09 Warranty - Each butterfly valve shall be furnished with a manufacturer's 10-year limited warranty against defects in materials and workmanship. Such warranty shall transfer to the District upon final acceptance of the improvements.

Section 307.03.10 Representative Models - Butterfly valves shall be Mueller® Lineseal®, M & H AWWA 450, Henry Pratt AWWA Style, or approved substitute.

Section 307.03.11 Construction and Installation - Each butterfly valve shall be installed in the locations and orientation provided for in the *Contract Documents*. Jointing to pipelines, fittings and other valves shall be in accordance with the provisions of Sections 303.02.03(a), "Mechanical Joints" and 303.02.03(b), "Flanged Joints" of these Standard Specifications.

Direct buried valves shall be supported by a block directly under the valve body. Such blocks shall be either redwood or pressure treated timber at least a nominal 4-inches in each dimension and 12-inches long. At the Contractor's option and subject to the Engineer's approval, other blocking materials, such as pier blocks, may be used. The valve shall be fully coated in accordance with Section 305, "Bolting Procedures" of these Standard Specifications. A valve box shall be installed over each valve in accordance with Section 308, "Concrete Structures" of these Standard Specifications.

Valves included in piping assemblies above grade or underground within vaults, shall be supported by the use of pipe supports. Pipe supports shall be installed on a concrete pad of at least 4-inch thickness and 18-inches square. Pipe supports shall be Grinnell Figure 264, Standon Pipe Support Model S-89, or approved substitute.

Section 307.03.12 Testing and Acceptance - All butterfly valves shall be inspected by the Engineer prior to installation. Upon installation, each valve shall be operated under no pressure prior to charging the line to verify free travel without interference. Upon charging the pipeline, each valve shall be included in the hydrostatic test as provided for in Section 301.05.07, "Hydrostatic Testing" of these Standard Specifications. Upon satisfactory completion of all work, each butterfly valve shall be operated under load to verify acceptable operation in accordance with the provisions of this Section 307.03. The Contractor shall bear full responsibility for the inspection, evaluation, removal, and replacement of defective butterfly valves as provided for in these Standard Specifications.

Section 307.03.13 Measurement and Payment

Section 307.03.13(a) Unit Basis - When butterfly valves are provided for in the *Contract Documents* to be paid for as a unit, the contract unit price per each shall include full compensation for all labor, materials, equipment, and tools and for doing all work required in installing butterfly valves including but not limited to, excavation, bedding, supports, providing the valve, connection to the pipeline or fitting, valve box, backfill, and pavement repair, complete in place as provided for in the *Contract Documents*, as provided for in these Standard Specifications, and as directed by the Engineer and no additional compensation will be allowed therefor.

Section 307.03.13(b) Incidental Basis - When a pay item for butterfly valves is not included in the *Contract Documents*, all costs for such butterfly valves as are provided for in the *Contract Documents* shall be considered as incidental to other items of work and all costs associated with such butterfly valves shall be included in the contract unit or lump sum prices for other items of work and no additional compensation allowed therefor.

Section 307.04 Control Valves

Section 307.04.01 Description - Control valves shall be those valves called for in the *Contract Documents* whose purpose is to provide operational control and protection to piping systems, assemblies, storage and pumping facilities. Such control valves shall be as described herein. Operating pressure rating shall be Class 150 or as called for in the *Contract Documents*.

Section 307.04.02 Basic Valve

Section 307.04.02(a) Description - The valve shall be hydraulically operated and diaphragm-actuated. The body and cover shall be fabricated of material in accordance with the mechanical schedule below.

MECHANICAL SCHEDULE - CONTROL VALVES

DESCRIPTION	MATERIAL	MATERIAL STANDARD
Body and cover	Ductile iron	ASTM A536
Cover gasket	Buna N Rubber	ASTM D2000
Bolts	Stainless Steel	Type 304
Stem	Stainless Steel	Type 303
Diaphragm	Nylon bonded w/ synthetic rubber	ASTM D2000
Seat Ring	Rubber	ASTM D2000

Nozzle plugs	Malleable iron	ASTM A865
Retaining screw	Stainless Steel	Type 304

Section 307.04.02(b) Coatings - The interior of the valve body, bonnet, and seal shall be fusion-bonded epoxy coated to a minimum thickness of 0.005-inches in accordance with AWWA C550. The exterior shall be either epoxy coated in accordance with AWWA C550 or coated with an asphaltic varnish in accordance with AWWA C110, Section 10-9.1, "Outside coating".

Section 307.04.02(c) Markings - Each valve body shall have the manufacturer's name and the valve size cast on the exterior of the body. Additionally, each valve, pilot valve, and solenoid shall be provided with a plate that enumerates the manufacturer's name, date of manufacture, size and type of valve, pressure rating, inlet and outlet, serial numbers, voltage ratings, and any additional information relevant to the particular valve. Alternatively, one plate may be used that provides this information on all valve components. This plate shall be permanently affixed to the valve with screws or rivets.

Section 307.04.02(d) Design and Operation - The diaphragm assembly shall consist of a valve stem and a nylon fabric bonded with synthetic rubber. The valve stem shall be the only moving part in the assembly and the diaphragm shall not be used as a seating surface. The valve stem shall be guided by a bearing in the valve cover and an integral bearing in the valve seat.

It shall contain a resilient, synthetic rubber disc of a rectangular cross section, contained on three and one-half sides by a disc retainer forming a tight seal against a single removable seat insert.

All external pipe and tubing required for pump operation shall be furnished with a polyurethane foam type pipe insulation to protect the valve components from freezing. Where called for in the *Contract Documents*, such pipe and tubing shall be equipped with in-line filters to remove particulate material from the control system.

All nozzles into the valve body shall be equipped with Flow Clean Strainers (Cla-Val Company Model X46).

Packing glands or stuffing boxes will not be permitted. Except for solenoid actuated valves, no pistons, linkages, external pressure source, or other mechanical device shall be used for pump operation or control.

All serviceable components of the valve shall be accessible with the valve in-situ. The valve body and cover shall be so designed as to permit conversion of the valve from one function to another without removing the valve from the line or requiring any modification to the valve body or cover such as drilling and tapping.

Section 307.04.02(e) Pressure Rating - Except as provided for in the *Contract Documents*, all control valves shall be rated for full operation at 150-psi steady-state working pressure and a maximum velocity of 20-fps.

Section 307.04.02(f) Ends and Body Type - Valve ends shall be flange type in accordance with Section 303.02, "Ductile Iron Fittings" of these Standard Specifications. Valves 3-inch and smaller may be threaded type in accordance with Section 302.05, "Iron Service Piping" of these Standard Specifications. Body style shall be either globe or angle as provided for in the *Contract Documents*.

Section 307.04.03 Check Valves - All check valves shall be so designed as to open fully to permit flow when the inlet pressure is greater than the outlet pressure. When the outlet pressure is higher than the inlet pressure, the valve shall close drip-tight in response to the difference in pressure between the valve chamber and the diaphragm chamber. The valve shall be equipped with auxiliary controls which will permit the adjustment of the opening and closing speeds. These speeds shall be set in accordance with the manufacturer's recommendations for the installation and operating conditions.

Check valves shall be Cla-Val Company Model 81-02; no substitute.

Section 307.04.04 Pressure Reducing Valves - Pressure reducing valves shall be pilot controlled valves that maintain the outlet pressure at a steady, preset pressure regardless of the inlet pressure or flow rate.

The pilot control system shall consist of a direct-acting, adjustable, spring-loaded, normally open, diaphragm valve. This valve shall be designed to permit flow when controlled pressure is less than the spring setting and shall include a fixed orifice.

Pressure reducing valves shall be Cla-Val Company Model 90-01; no substitute.

Section 307.04.05 Pressure Relief, Pressure Sustaining, and Back Pressure Valves - Pressure relief, pressure sustaining, and back pressure valves shall be pilot controlled valves that maintain the inlet pressure at a steady, preset pressure regardless of the outlet demand.

The pilot control system shall consist of a direct-acting, adjustable, spring-loaded, normally open, diaphragm valve. This valve shall be designed to permit flow when controlled pressure is exceeds the spring setting. The pilot control system shall operate such that as excess pressure in the pilot valve is dissipated the main valve shall close gradually to a drip-tight seating.

When used as a pressure relief valve, the valve shall be installed to protect piping systems from high surge pressures due to pump operations. The valve shall relieve such surges by shunting excess pressure surges to a zone of lower pressure. The routing of the relief valve will be shown in the *Contract Documents*.

When used as a pressure sustaining valve, the valve shall be installed in line with the piping between zones of higher and lower pressure to maintain the preset upstream pressure during periods of high demand in the lower zone. As the demand increases the valve shall close gradually to prevent robbing from the upper zone.

When used as a back pressure valve, the valve shall be installed off-line at the discharge of a pump to shunt pressure fluctuations to the suction side of the pump and maintain a constant discharge pressure.

In all configurations, the valve shall operate automatically without additional field adjustment.

Pressure relief, pressure sustaining, and back pressure valves shall be Cla-Val Company Model 50-01; no substitute.

Section 307.04.06 Surge Anticipator Valve - A surge anticipator valve shall be installed to protect all pump stations where the calculated water hammer will increase the pressure in the system in excess of the design working pressure rating of that system or where called for in the *Contract Documents*. The time of closure to prevent the formation of such water hammer shall be as follows:

$$Tc = [0.027 \times L \times V]/[\Delta p]$$

Where: Tc = Time of closure (seconds)
L = Length of pipeline (feet)
V = Velocity of pipeline flow (fps)
Δp = Change in pressure from full flow to no flow (psi)

The increase in pressure due to this surge shall be assumed to equal a value in psi of 60 times the pipeline velocity at normal flow.

Such surge anticipator valves shall be equipped with multiple pilot valves that will open the valve rapidly in response to high pressure or low pressure wave in the piping system. On a low pressure wave, the main valve shall open to a preset limit as controlled by a hydraulic limiter. Upon dissipation of the high pressure wave the valve shall close slowly to drip-tight.

The surge anticipator valve shall be installed in such a manner as to shunt the high pressure wave out of the system to an area of lower pressure, preferably atmospheric. The routing of this discharge shall be as called for in the

Contract Documents.

Surge anticipator valves shall be Cla-Val Company Model 52-03; no substitute.

Section 307.04.07 Pump Control Valves - Pump control valves shall be installed on the discharge head of all pumps to regulate the rate of energy transfer from the pump to the receiving system. The valve shall also include an integral check capability to prevent a flow reversal.

The valve shall be controlled by means of an externally mounted, four-way, solenoid pilot valve. The valve shall utilize line pressure for operation without external sources. A limit switch shall be installed that is adjustable throughout the entire range of valve travel. The control system shall be protected by self-cleaning strainers.

The pump control valve shall open slowly upon receiving a signal from the Motor Control Center that pump startup has been initiated. Upon receiving a signal terminating pump operation, the valve shall slowly close drip-tight sealing the valve against flow reversal by the use of the check feature. This rate of opening and closing shall be field adjustable. The rate of both opening and closing shall be determined from the operating conditions and shall permit sufficient time for the dissipation of surge pressures and water hammer.

Pump control valves shall be Cla-Val Company Model 60-11; no substitute.

Section 307.04.08 Deep Well Pump Control Valves - Deep well pump control valves shall be installed on the discharge head of all well pumps to regulate the rate of energy transfer from the pump to the receiving system. The valve shall also include a flushing capability to prevent the introduction of sand and standing water in the well to the receiving system.

The valve shall be controlled by means of an externally mounted, four-way, solenoid pilot valve. The valve shall utilize line pressure for operation without external sources. A micro switch shall be installed to control the valve. The control system shall be protected by self-cleaning strainers.

The deep well pump control valve shall close slowly upon receiving a signal from the Motor Control Center that pump startup has been initiated. Upon receiving a signal terminating pump operation, the valve shall slowly open. This rate of opening and closing shall be field adjustable. The rate of both opening and closing shall be determined from the operating conditions and shall permit sufficient time for the dissipation of surge pressures and the flushing of the pump column.

The deep well pump control valve shall be installed in such a manner as to shunt the initial water column out of the system to an area of lower pressure, preferably atmospheric. The amount of time for the valve to close shall be determined such that the volume of the pump column is completely flushed. Additional time may be required to flush sand drawn into the well casing during pump startup. This additional time will be determined in the field at the time of installation. The routing of this discharge shall be as called for in the *Contract Documents*.

Pump control valves shall be Cla-Val Company Model 61-02; no substitute.

Section 307.04.09 Combination Valves - Multiple functions may be included in one valve, subject to the Engineer's approval. When permitted, multi-purpose valves shall be assembled in strict accordance with the manufacturer's recommendations. No field modifications to create multiple functions will be permitted without direct supervision by the manufacturer's representative.

Section 307.04.10 Warranty - Each control valve shall be furnished with a manufacturer's 3-year limited warranty against defects in materials and workmanship. Such warranty shall transfer to the District upon final acceptance of the improvements.

Section 307.04.11 Construction and Installation - Each control valve shall be installed in the locations and orientation provided for in the *Contract Documents*. Jointing to pipelines, fittings and other valves shall be in accordance with the provisions of Section 303.02.03(b), "Flanged Joints" of these Standard Specifications.

Control valves installed below grade shall be installed in a valve vault in accordance with Section 308, "Concrete Structures" of these Standard Specifications.

Control valves shall be supported by the use of pipe supports. Pipe supports shall be Grinnell Figure 264, Standon Pipe Support Model S-89, or approved substitute.

Pipe supports shall be installed on a concrete pad of at least 4-inch thickness and 18-inches square.

Section 307.04.12 Testing and Acceptance - All control valves shall be inspected by the Engineer prior to installation. Upon installation, each valve shall be set to the operating settings recommended for the particular application. Following setting, each control valve shall be operated under load to verify acceptable operation in accordance with the provisions of this Section 307.04. The Contractor shall bear full responsibility for the inspection, evaluation, removal, and replacement of defective control valves as provided for in these Standard Specifications.

Section 307.04.13 Measurement and Payment

Section 307.04.13(a) Unit Basis - When control valves are provided for in the *Contract Documents* to be paid for as a unit, the contract unit price per each shall include full compensation for all labor, materials, equipment, and tools and for doing all work required in installing control valves including but not limited to, excavation, bedding, supports, providing the valve, connection to the pipeline or fitting, setting and testing, valve vault, backfill, and pavement repair, complete in place as provided for in the *Contract Documents*, as provided for in these Standard Specifications, and as directed by the Engineer and no additional compensation will be allowed therefor.

Section 307.04.13(b) Incidental Basis - When a pay item for control valves is not included in the *Contract Documents*, all costs for such control valves as are provided for in the *Contract Documents* shall be considered as incidental to other items of work and all costs associated with such control valves shall be included in the contract unit or lump sum prices for other items of work and no additional compensation allowed therefor.

Section 307.05 Fire Hydrants

Section 307.05.01 Description - Fire hydrants shall be installed where called for in the *Contract Documents*. All such fire hydrants shall be of the wet barrel design and shall be manufactured in accordance with the provisions of AWWA C503. Each hydrant shall be equipped with one 4-½ inch and either one or two 2-½ inch steamer ports. The number of 2-½ inch ports shall be as called for in the *Contract Documents*. Each port shall be threaded to National Standard Hose Thread. The cap shall be equipped with a pentagonal nut of the same size as the operating nut and shall be chained to the hydrant barrel. The chain shall be so attached to the cap as to prevent its removal while permitting free rotation of the cap. Operating pressure rating for fire hydrants shall be 150 psi or as called for in the *Contract Documents*.

Each hydrant shall be equipped with a cast or ductile iron base shoe as manufactured by Long Beach Iron Works or approved substitute and sufficient risers to bring the hydrant to final grade.

Where provided for in the *Contract Documents*, the hydrant shall be equipped with a riser check valve assembly to prevent excessive discharge in the event of a break off of the hydrant. Such check valve assembly shall be capable of providing uninterrupted flow under normal operation and a slow closing capability following hydrant breakoff. The hydrant check valve shall be as manufactured by Little Squirt Manufacturing or approved substitute.

Section 307.05.02 Coatings - All hydrants shall be painted with a minimum of one coat of OSHA yellow paint. Paint shall be Rust-Oleum 2143, DuPont 23663D, Aervoe 302, or Krylon 1813.

Section 307.05.03 Markings - Each hydrant body shall have the manufacturer's name and the valve size cast on the exterior of the body.

Section 307.05.04 Design and Operation - All serviceable components of the hydrant shall be accessible with the hydrant in-situ. The hydrant shall open counterclockwise with a 1-¼ inch pentagonal operating nut. The riser shall be equipped with a traffic breakaway spool and shear bolts. Each port shall operate independently. The discharge nozzles shall be in accordance with NFPA 1963, "Standard for Screw Threads and Gaskets for Fire Hose Connections". Nozzles shall be threaded to such a length as to provide a minimum of 4 to 5 threads. The hydrant shoe shall be of the mechanical joint type with the retaining or follower gland replaced with a thrust restraining follower gland in accordance with Section 304, "Thrust Restraint" of these Standard Specifications. The hydrant shoe shall permit full flow with a minimum of losses.

Shear or breakaway bolts shall be fabricated of full thread bolts with a machined hole bored in the center of the shaft. The bolt shall be capable of withstanding a torque of 70 ft-lbs and shear between 90 and 105 ft-lbs torque. Breakaway spools shall be a standard riser with a machined groove in the barrel that will shear under vehicle impact. The groove shall be a machined 45° V-groove of suffucient depth to reduce the barrel wall thickness to one-half the nominal thickness when measured from the interior wall.

Fire hydrant isolation valves shall be standard flange by mechanical joint resilient seat gate valves in accordance with Section 307.02, "Gate Valves" of these Standard Specifications. The retaining follower gland shall be replaced with a thrust restraining follower gland in accordance with Section 304, "Thrust Restraint" of these Standard Specifications. Such valves shall be installed at the main line fitting and supplied with a standard valve box in accordance with Section 308, "Concrete Structures" of these Standard Specifications.

The top flange of the base shoe or riser shall be of the 6-hole pattern using ¾-inch diameter shear bolts. Gaskets shall be of the ring type in accordance with Section 303.02.02(c), "Flanged Fittings" of these Standard Specifications. The lower joint shall be mechanical joint in accordance with Section 303.02.02(b), "Mechanical Joint Fittings" of these Standard Specifications.

Section 307.05.04 Representative Models - Fire hydrants shall be James Jones Model J3740 or J3760, Long Beach Iron Works Model B125 or B130, or approved substitute.

Section 307.05.05 Construction and Installation - Each fire hydrant shall be installed in such a manner as to permit a minimum clear distance from any obstruction to the center of the hydrant of 3-feet. The hydrant shall be set a minimum of 18-inches from the back of curb or edge of travelled way to the nearest point on a port cap. The horizontal location shall be as called for in the *Contract Documents* except that the Engineer reserves the right to adjust the location up to 20-feet in any direction in response to conditions found in the field. Such conditions shall include but not be limited to, the location of other utilities, driveways, private improvements such as landscaping and earth retaining structures, and the location of pipe joints. Such adjustment, if required, will be made in full cooperation with the Contractor during the laying out of the pipeline and shall be considered as included in the contract unit or lump sum price for the fire hydrant and no additional compensation will be allowed therefor.

Insofar as practicable, fire hydrants shall be located at the projection of property lines within the public Right-of-Way and on the uphill side of the roadway. Where the proper location of the fire hydrant requires excavating into the adjacent slope and it is impracticable to maintain a slope of two horizontal to one (2:1) vertical or flatter, the Contractor shall construct a low retaining wall around the hydrant at the clearances provided for herein. Such retaining walls shall be constructed of precast modular concrete units with geotechnical fabric (Keystone with Tensar, or approved substitute). The cost of such retaining structures shall be considered as included in the contract unit price for other items of work and no additional compensation will be allowed therefor.

Where called for in the *Contract Documents*, fire hydrants shall be protected by the installation of traffic barriers. Such barriers shall be constructed of 4-inch nominal diameter galvanized iron pipe 3-feet high set a minimum of 3-feet into the ground with a fence post cap. The post hole and the pipe shall be filled with Class "B" concrete. The posts shall be installed in locations that provide the offsets called for herein and 18-inches clearance to the nearest point on the hydrant. The posts shall be so situated as to protect the hydrant from any direction traffic may be expected. Each post shall be painted to match the fire hydrant.

All hydrants shall be set in a pad of Class "B" concrete not less than 36-inches square and 6-inches thick. In

sidewalk areas, the sidewalk shall be thickened and widened as necessary to conform with these requirements. The hydrant shall be set such that the top flange of the first buried spool below the breakaway spool is no less than 1-½ inches and no more than 2-inches above the pad. Bolts shall be inserted from the top down with the nuts on the underside of the flange. In pouring concrete for the pad, the bolts shall be protected from any concrete and shall not be permitted to extend closer than _-inch to the surface of the pad. All bolt ends shall be painted with a coat of bitumastic type material (Protecto Wrap 160/160H, Tapecoat Brush-Applied Coating, or approved substitute).

The breakaway bolts shall be installed with the nut down and the hole sealed with either a bitumastic compound or silicon caulk. Break off spools having only one groove eccentrically located shall be installed with the groove at the low end of the spool.

Upon completion of the installation of the fire hydrant, the Contractor shall assist the Engineer in performing a flow test of the hydrant. Such assitance shall include but not be limited to hoses, nozzles, and directing the flow to a safe discharge point. The Engineer shall take all measurements related to the measurement of flow.

Hydrostatic testing and disinfection shall be accomplished in accordance with the provisions of Section 301.05.07," Hydrostatic Testing" and Section 301.05.08, "Disinfection" of these Standard Specifications.

Section 307.05.06 Measurement and Payment - The contract unit price per each for fire hydrant shall include full compensation for all labor, materials, equipment, and tools and for doing all work required in installing the fire hydrant including but not limited to, excavation, bedding, providing the hydrant, connection to the main pipeline, isolation valve, thrust restraint, hydrant pad, painting, breakway bolts and spools, backfill, retaining wall, traffic barriers, and pavement repair, complete in place as provided for in the *Contract Documents*, as provided for in these Standard Specifications, and as directed by the Engineer and no additional compensation will be allowed therefor.

SECTION 308 CONCRETE STRUCTURES

Section 308.01 Description - Minor concrete structures shall include but not be limited to, all precast concrete structures, cast-in-place concrete for thrust blocks, valve and hydrant pads, walks, curbs, and driveways, and pipe supporting structures.

Major concrete structures shall include but not be limited to retaining walls, pump buildings, pump pedestals, and other structures intended to support significant structural loads, vibrations, or where the failure of such structures could result in a significant risk to life, property, or equipment. Such structures shall be designed by a registered Civil or Structural Engineer licensed by the State of California. Specific provisions related to such structures will be provided for in the *Contract Documents*.

The Contractor shall submit copies of mix designs, structural details, structural calculations and testing, Certificates of Compliance and other data and documents in accordance with the provisions of Section 107.10, "Submittals" of these Standard Specifications and the *Contract Documents*.

Section 308.02 Materials

Section 308.02.01 Portland Cement - Except as provided for in the *Contract Documents*, portland cement used in concrete structures shall be Type IP (MS) Modified or Type II Modified cement conforming with the requirements of ASTM C595, ASTM C150, and Section 90-2, "Materials" of the State Standard Specifications.

Section 308.02.03 Aggregate - Except as provided for in the *Contract Documents*, aggregate shall conform with the provisions of Section 90-2, "Materials" of the State Standard Specifications.

Section 308.02.04 Reinforcement - Except as provided for in the *Contract Documents*, all reinforcement shall conform with the requirements of Section 52, "Reinforcement" of the State Standard Specifications.

Section 308.02.05 Classes of Concrete - All portland cement concrete shall be one of the following classes, as provided for elsewhere in these Standard Specifications and the *Contract Documents*:

Class "A": 564 pounds of cement per cubic yard (minimum)
Class "B": 470 pounds of cement per cubic yard (minimum)

Generally, all major concrete structures shall be constructed of Class "A" concrete. All minor structures exposed to traffic loads including but not limited to, drainage inlets, manholes and bases, curb and gutter, and driveway approaches shall be constructed of Class "A" concrete.

Minor structures not exposed to traffic loads may be constructed of Class "B" concrete. Such minor structures shall include but are not limited to, pipe and valve supports, sidewalks, hydrant pads, sanitary seals, post bases, thrust blocks, and channel linings.

Section 308.03 Minor Concrete Structures

Section 308.03.01 Precast Concrete Structures - Precast structures shall include but not be limited to, valve boxes, meter boxes, vaults, drainage inlets, and manholes. Precast structures shall be manufactured by experienced manufacturers having a minimum of 5-years experience in the manufacture of precast concrete structures of the type called for in the *Contract Documents*.

Precast structures shall be as follows:

Meter Boxes ..... Christy Concrete Products Model B-9
Valve Boxes ..... Christy Concrete Products Model G5
Valve Vaults ..... Christy Concrete Products "R" Series Pits
Utility Vault Company LA Series Vaults
Manholes ..... Hanson Concrete Products
Santa Rosa Cast Products
Drainage Inlets ..... Christy Concrete Products V64 or U-Series
Santa Rosa Cast Products K or L Series

Lids and Covers:

Meter Boxes ..... Christy Concrete Products Model B9D
Traffic: Christy Concrete Products Model B9C
Valve Boxes ..... Christy Concrete Products Model G5C

Valve Vaults ..... Utility Vault Company Model 44-332P
Utility Vault Company Model 64-3660
Manhole Frame and Cover ..... Phoenix Iron Works Model P-1090
Drainage Inlets ..... Phoenix Iron Works Model P-6301 or P-6302
Christy Concrete Products RHD Series

All valve vaults larger than 2-feet square shall be equipped with torsion-assisted lids. All lids within the travelled way shall be designed for an AASHTO H20-S44 traffic load. Each such lid shall be equipped with a bolt down system or other, approved security system to prevent unauthorized entry.

The citing of specific models herein is solely for the purpose of demonstrating the type, style, function, method of operation, and level of performance desired for precast concrete products by the District. The Contractor shall provide the appropriate model of structure provided for in the *Contract Documents* with regard to size, depth, traffic loads, opening size, lids and covers, and wall penetrations and other special provisions dictated by the service condition.

All manholes shall conform with the provisions of ASTM C478 and shall be equipped with standard 24-inch heavy duty traffic lids manufactured from gray cast iron conforming with ASTM A48. Manhole frame and covers shall be Phoenix Iron Works Model P-1090 or approved substitute. Letters identifying the type of utility will be provided for

in the *Contract Documents*. Manholes greater than 5-feet in depth shall be provided with galvanized or synthetic rungs cast in the barrel section in accordance with ASTM C478. Reducing cones and risers shall be as provided for in the *Contract Documents*.

All drainage inlets shall be supplied with welded and riveted reticuline type grates (Phoenix Iron Works Model P-6301 or P-6302) or approved substitute. All grates shall be designed for an AASHTO H20-S44 traffic load. The dimensions of the grate shall be as provided for in the *Contract Documents*.

Insofar as practicable, all precast concrete structures shall be provided with precast openings for the installation of pipe through the wall. Where provided for in the *Contract Documents*, such wall openings shall be sized to permit sealing the annular space with a mechanical seal (Calpico Pipe Lynx, Thunderline Link-seal, or approved substitute).

Where provided for in the *Contract Documents*, drainage inlets and manholes shall be provided with panels cast in the walls for removal to insert the drainage pipe.

Section 308.03.02 Construction and Installation

Section 308.03.02(a) Description - The Contractor and the supplier shall provide all equipment, tools, materials, and labor, including but not limited to, trucks, transporters, drivers, operators, cranes, slings, hooks, and other facilities and tools as are necessary to transport plastic concrete or precast structures to the site of work and install it as called for in the *Contract Documents*. Such equipment, tools, materials, and labor shall be sufficient to move the structure to the point of installation and to install such structure safely and efficiently.

Section 308.03.02(b) Bedding and Backfill - Except for meter boxes or valve boxes, all precast structures shall be bedded on a minimum of 6-inches of clean sand or aggregate base rock compacted to 95-percent relative compaction. The excavation, including that for valve boxes, shall then be backfilled with a sand-cement slurry mix in accordance with Section 309, "Bedding, Backfill, and Aggregate Bases" of these Standard Specifications.

Section 308.03.02(c) Cast-In-Place Bases - Where precast concrete structures are to be installed over cast-in-place bases, the excavation shall be made and a minimum of 6-inches of clean sand or aggregate base compacted to 95-percent shall be installed prior to pouring concrete. The base shall be cast to the dimensions and of the class of concrete called for in the *Contract Documents*. The base shall have a keyway cast to conform with the dimensions of the precast structure. The precast structure shall not be installed prior to the base achieving a curing level that will support the structure without deformation or damage. Indentation of the base surface will not be considered deformation. If the base visibly deforms or is otherwise damaged when loaded with the structure, the structure shall be removed and the base repaired or removed, at the Engineer's direction. Prior to placing the structure on the base the Contractor shall install a self-sealing joint compound such as Ram-Nek to the interface. Each succeeding riser of the structure shall also be placed on such a sealing compound.

Section 308.03.02(d) Grouting - Where provided for in the *Contract Documents*, the Contractor shall grout the annular space between the pipe wall and the structure opening. Grout may also be required to provide a smooth finished surface. Such grout shall consist of equal amounts of portland cement and mason's sand. White glue suitable for use as a concrete adhesive may be substituted for all or part of the water used in mixing the grout. Grout shall be of a stiff enough consistency to conform to the shape of the space or surface being grouted while still being workable. The surface being grouted shall be thoroughly cleaned of all deleterious material and wetted to the point where no water is readily absorbed but with no standing water on the surface. A thin layer of white glue may be applied to the surface immediately prior to commencing the grouting.

Grout shall be laid on smoothly with a steel trowel in thin lifts. Where the weight of the grout pulls the grout away from the structure wall, the grout shall be removed and a thinner lift applied. The final lift of grout shall conform to or provide a smooth transition to the surfaces being grouted. Grout shall extend to the full depth of annular spaces. Grout shall be kept moist for a minimum of 24-hours to facilitate proper curing. Quick curing cements may be used upon prior approval by the Engineer.

Grout under structure bases including but not limited to light standards shall be a non-shrink grout conforming with ASTM C1107. The grout shall be installed in accordance with the manufacturer's recommendation, including sealing of the outer surfaces. The edges shall be struck off at a 45-degree batter.

Section 308.03.03 Cast-In-Place Concrete Structures - Cast-in-place concrete structures shall include but not be limited to drainage inlets, valve vaults, curb or curb and gutter, sidewalk, channel linings, and other minor structures as provided for in the *Contract Documents*.

Section 308.03.04 Surface Finishes - All concrete structures shall receive the following surface finishes:

1. Buried surfaces ..... Ordinary surface finish
2. Exposed vertical surfaces ..... Class I surface finish
3. Sidewalks ..... Fine broom Finish
4. Face of curbs ..... Fine broom finish
5. Gutter lines ..... Steel trowel finish
6. Channel linings ..... Steel Trowel or fine broom finish
7. Manhole and inlet shelves ..... Medium broom finish

Finishes required above are hereby defined as follows:

Ordinary surface finish: That finish resulting from direct contact with form materials without any additional treatment

Class I surface finish: That finish resulting from direct contact with form materials that has additionally been treated to remove blemishes including but not limited to, form marks, pockets, depressions, honeycombs, bulges, and other unsightly surface defects. Such additional treatment shall include but not be limited to, grinding, sacking, trowelling, packing, and grout patching. The method of treatment shall be at the Contractor's discretion. The Engineer shall be the sole judge of the final condition of the finish.

Fine broom finish: That finish resulting from lightly brooming the concrete surface with a fine horsehair broom perpendicular to the long axis of the surface. The surface shall first be floated and trowelled to a smooth surface and edges and joints finished. When the concrete has taken its initial set and no additional paste worked to the surface, the surface shall be broomed. Care shall be taken to prevent filling any joints or breaking the radius of finished edges. All such defects shall be promptly retooled. All broom marks shall be continuous across the entire width of the surface. Deficiencies in the brooming shall be corrected by brooming the entire width of that area in one pass.

Medium broom finish: This finish shall be constructed in the same manner as that for a fine broom finish except that a stiffer broom shall be used. In no case shall the Contractor accomplish this finish by working an excess of paste to the surface to increase the relief of the finish surface.

Steel trowel finish: This finish shall be constructed in the same manner as that for the broom finishes except that the final surface shall be accomplished by use of a steel trowel of sufficient length to create a smooth surface across the full width of the concrete being finished. In no case shall the Contractor accomplish this finish by working an excess of paste to the surface to increase the polish of the finish surface.

Section 308.03.05 Preparation and Forms - In preparing the area of work to receive cast-in-place concrete structures, the Contractor shall excavate the area to sound native material, removing all deleterious material found. The excavation shall be of sufficient depth to accommodate the structure plus the bedding or leveling course.

All existing concrete and asphalt surfaces to which the proposed concrete structure shall be joined or abutted shall be sawcut to a minimum of one-half the depth of the existing material. The existing surface shall be cleaned and wetted

prior to placing new concrete. Where called for in the *Contract Documents*, dowels shall be inserted into existing concrete and grouted in place.

Where the *Contract Documents* provide for new concrete to bond to existing concrete, the existing concrete shall be prepared in accordance with the provisions for grouting in Section 308.03.02(d), "Grouting" of these Standard Specifications. A thin coat of white glue or other approved bonding adhesive shall be applied to the existing surface immediately prior to placing new concrete.

Forms shall be constructed of either sound structural grades of lumber and plywood or steel, as required by the structure to be constructed. The forms shall be securely staked and braced to maintain the lines and grades called for in the *Contract Documents* when filled with plastic concrete. When major structures are provided for in the *Contract Documents*, all forms and falsework shall be in accordance with such provisions. All forms shall be coated with a form releasing agent before placing concrete. Care shall be taken to prevent release agent from coating any materials embedded in the concrete except as called for in the *Contract Documents*.

All reinforcing steel shall be securely tied in the configuration called for in the *Contract Documents* and placed to grade in the forms using epoxy coated chairs or other supports. If appropriate, the steel may be suspended from the top of the forms for such structures as light pole bases.

All anchor bolts, conduit, pipe, and ductwork shall be secured within the forms in the final configuration such that the placement of concrete does not disturb the position of such devices.

All forms and embedments including but not limited to, reinforcing steel, bedding and leveling courses, pipe, anchor bolts, and ductwork shall be inspected and approved by the Engineer prior to placing concrete. Failure to obtain this approval prior to placing concrete may be cause for rejection of the structure by the Engineer and all costs associated with such rejection, including but not limited to, removal and replacement or remedial work shall be borne by the Contractor and no additional compensation will be allowed therefor.

Immediately prior to placing concrete, all surfaces within the forms shall be thoroughly wetted. The bedding or base course shall be saturated up to the point that standing water appears.

Section 308.03.06 Jointing and Tooling - The Contractor shall construct expansion joints between adjacent concrete structures as called for in the Contract Documents or as required by agencies having jurisdiction over the work. In the absence of such direction for curb, gutter, and sidewalks, the Contractor shall construct an expansion joint at maximum intervals of 60-feet, at the beginning and ending of curb returns and driveways, and around precast structures such as utility vaults. Contraction joints shall be constructed at maximum intervals of 20-feet between expansion joints. Where curb and sidewalk are placed monolithically, a contraction joint shall be constructed at the back of the curb and the joint finished as described herein. The exact spacing of joints shall be determined in the field and shall, insofar as practicable, divide the work into even multiples of the total length most closely conforming with these provisions.

Expansion joints shall be constructed using ½-inch preformed, impregnated fiber filler material conforming with the provisions of ASTM D1751. The filler shall extend the full depth of the concrete and in one continuous piece across the full width of the structure.

Contraction joints shall be constructed by driving a steel trowel or similar tool to at least half the depth of the concrete.

All expansion and contraction joints shall match between the curb and sidewalk. Joints and tooling in new sidewalk against old curb shall match those of the curb. Monolithic curb and sidewalk shall have the joint continuous through both structures.
Sidewalks shall be further divided by tooling marks at intervals to approximate the width of the sidewalk. Such tooling shall penetrate no more than ½-inch into the concrete.

All joints shall be finished by use of a grooving tool or radius trowel with a ½-inch radius.

Section 308.03.07 Placement - All concrete shall be placed in a continuous operation to the limits that can be properly finished in the normal workday. As required by the structure being constructed, the Contractor shall use such methods and devices as are necessary to prevent segregation of aggregates within the mix. Such methods and devices shall include but not be limited to, pumping, chutes, and buggies.

Concrete shall be placed from the lowest point in the forms to the highest and struck off flush to the top of the forms preparatory to finishing. As required by the structure being constructed, concrete shall be tamped, rodded, or vibrated within the forms to ensure full face contact with the forms and all embedments with no pockets of aggregate being formed. Care shall be taken to prevent any displacement of the forms and embedments while agitating the plastic concrete. Concrete vibrators shall not be permitted to contact reinforcing steel or other embedments.

Where work will recommence at a later date, the interface shall be defined by a form as provided for herein. Dowels shall be installed where provided for in the *Contract Documents*. No concrete shall be placed until sufficient trained personnel are available to place and finish the concrete properly. Failure to provide sufficient personnel to accomplish the work shall be cause to delay the placement and the Contractor shall bear all costs associated with such delay.

Concrete shall be delivered with a sufficient water/cement ratio to permit a slump of 2-inches to 4-inches at the design strength specified. The addition of water to cool the mix or otherwise influence the curing rate shall be cause for rejection of all such altered concrete.

Concrete shall be freshly mixed and placed prior to the commencement of the curing reaction. Concrete that has experienced in excess of 250 revolutions in a transit mix truck, has not been discharged within 1-½ hours of batching out, or that has attained a temperature in excess of 90 degrees Fahrenheit shall be rejected. The load ticket accompanying the load shall show the date and time of batching out, initial revolution counter reading, and the project name. Any concrete placed exceeding these conditions shall be removed and disposed of in accordance with Section 202.02.04, "Disposal" of these Standard Specifications. The Contractor shall bear all costs associated with the rejection of such defective concrete including but not limited to, standby time, disposal of defective concrete not yet incorporated in the work, removal of such defective concrete from the site of work, and replacement of such defective concrete.

The Contractor shall cure the concrete by use of a curing compound conforming with the provisions of ASTM C309. The selection of the compound shall be the Contractor's. Alternatively, the Contractor may choose to use a wet curing method wherein the surface of the concrete is kept continuously wet for a minimum period of 72-hours. This may be accomplished by the use of sand blankets, burlap sacking, carpeting, and polyethylene sheeting at the Contractor's discretion and subject to the Engineer's prior approval.

The Contractor shall protect the finish of the concrete from all damage during curing including but not limited to vandalism, shrinkage cracks due to improper curing, footprints and wheel tracks, and marks from the wet curing method, if used. All vehicular traffic shall be kept off the fresh concrete for a minimum period of 7-days and vehicles in excess of 3-tons GVW for a period of 28-days. The Contractor shall not commence structural work that will load the concrete for a minimum period of 7-days or until the concrete has attained _ of the 28-day compressive strength, whichever is the earliest.

SECTION 309 BEDDING, BACKFILL, AND AGGREGATE BASES

Section 309.01 Description - Bedding shall be that material placed to a minimum depth of 4-inches below and 12-inches above all pipe, fittings, valves, and structures. Backfill shall be that material used to fill trenches and excavated areas above the depth of the bedding. Aggregate base shall be that material placed immediately below all paved surfaces and may be used as the final paving surface where provided for in the *Contract Documents*. All bedding, backfill, and aggregate base shall be in accordance with these Standard Specifications, the *Contract Documents*, and the requirements of agencies having jurisdiction over the work.

Section 309.02 Bedding - Except as provided for in the *Contract Documents*, bedding material shall be clean,

washed, granular material derived from decomposed or crushed rock. Such material shall be free of organic material, mica, clay, silt, oils, and other deleterious material. Sand bedding shall have a maximum particle size of ¼-inch with a gradation that allows 90 to 100 percent to pass a Nº. 4 sieve and not more than 5 percent to pass a Nº. 200 sieve.

Section 309.03 Backfill

Section 309.03.01 General - Except as provided for in the *Contract Documents*, the minimum backfill required within each jurisdiction within the District shall be as follows:

Santa Cruz County Right-of-Way

Longitudinal trenches ..... Sand
Transverse trenches ..... 1-sack Sand/Cement Slurry
(including but not limited to main crossings and service lines)
Structure excavations ..... 2-sack Sand/Cement Slurry
(including but not limited to, valves, meters, and vaults)

City of Capitola Right-of-Way

All excavations ..... 1-sack Sand/Cement Slurry

State of California

Longitudinal trenches ..... Sand
Transverse trenches ..... 2-sack Sand/Cement Slurry
(including but not limited to main crossings and service lines)
Structure excavations ..... 2-sack Sand/Cement Slurry
(including but not limited to, valves, meters, and vaults)

Unimproved areas not subject to vehicle travel

All excavations ..... Native Material (min. Sand Equivalent of 20)

Unimproved areas subject to vehicle travel

All excavations ..... Sand

At the Contractor's option and subject to the prior approval of the Engineer, the Contractor may use backfill materials of a higher grade than that shown herein. Except as provided for in the *Contract Documents*, no additional compensation will be allowed for the use of materials of a higher grade than these minimum requirements.

Section 309.03.02 Sand Backfill - Sand backfill shall be a clean, washed, granular material conforming with the requirements of Section 309.02, "Bedding" of these Standard Specifications.

Section 309.03.03 Crushed Aggregate Backfill - Crushed aggregate backfill shall be a crushed gravel or rock material free from organic material, mica, clay, silt, oils, and other deleterious material. For trench backfill, the maximum particle size shall be 3-inches and the gradation shall otherwise conform with the following:

Minimum Sand Equivalent 20

Sieve Sizes	Percentage Passing
3-inch	100
Nº. 4	35-100

Nº. 30	20-100

At the Contractor's option and subject to the approval of the Engineer, the Contractor may substitute aggregate base material otherwise conforming with Section 309.04, "Aggregate Bases" of these Standard Specifications.

Section 309.03.04 Pervious Backfill - Pervious backfill shall be a poorly graded gravel or crushed rock meeting the following gradation:

Sieve Sizes	Percentage Passing
1-inch	100
¾-inch	90-100
_-inch	40-100
No. 4	25-40
No. 8	18-33
No. 30	5-15
Nº. 50	0-7
Nº. 200	0-3

Durability Index	≥40
Sand Equivalent	≥75

Section 309.03.05 Sand/Cement Slurry Backfill - Sand/cement slurry backfill shall consist of a fluid, workable mixture of aggregate, cement, and water. Aggregate for sand/cement slurry shall be a clean, washed fine aggregate conforming with the provisions of Section 309.02, "Sand Bedding" of these Standard Specifications. Alternatively, fine aggregate may be clean mortar sand conforming with the provisions of ASTM C404.

Cement shall be Type IP or Type II Modified in accordance with Section 308.02.01, "Portland Cement" of these Standard Specifications.

Water shall be clean, potable water free of organic contaminants, oils, salts, or other deleterious materials.

Section 309.04 Aggregate Bases - Aggregate base and subbase material shall be crushed rock or gravel free from organic material, oils, and other deleterious substances.

Aggregate base material for use under paved surfaces shall be Class 2 conforming with the following gradation:

Minimum Sand Equivalent	25
Minimum Resistance (R-value)	78
Minimum Durability Index	35

Sieve Size	Percentage Passing	
	1-½ Max.	*¾-inch Max.*
2-inch	100	-
1-½ inch	90-100	-
1-inch	-	100
¾-inch	50-85	90-100
Nº. 4	25-45	35-60
Nº. 30	10-25	10-30
Nº. 200	2-9	2-9

Section 309.05 Installation and Construction

Section 309.05.01 General - All bedding, backfill, and aggregate base material shall be delivered to the work areas in such a manner as to protect them from the introduction of organic material, oils and salts, native soils, cement and

concrete and other deleterious materials. The Contractor shall bear full responsibility for the transportation of materials including but not limited to, weight limits, vehicle dimensions, vehicle condition, and load covers.

Upon arrival at the work area, materials shall be incorporated into the work as soon as practicable. Materials not immediately incorporated into the work shall be stored in a suitable area where the material shall be protected from the introduction of any deleterious materials. The storage area shall be protected from traffic at all times except as required for the delivery of materials or work related to their incorporation into the work.

The Contractor shall provide such measures as may be required by the field conditions to prevent such conditions as, but not limited to, excessive dust, ponding of water, rerouted runoff that causes erosion, unsafe conditions, and any other condition that poses a hazard to the public or the quality and sufficiency of the material.

Section 309.05.02 Moisture Conditioning - The Contractor shall bring the bedding, backfill, and aggregate base material to the optimum moisture content as determined from laboratory analysis of the samples provided for in Section 107.10, "Submittals" of these Standard Specifications.

Adjustments to the moisture content shall be by a means selected by the Contractor that will ensure full and even distribution of moisture throughout the material. Such means shall include but not be limited to, windrowing, irrigating, mixing, spreading, and sprinkling. Except as provided for in the *Contract Documents*, jetting and ponding will not be permitted. Jetting is hereby defined as the injection of large volumes of water directly into the material with a nozzle under pressure. Ponding is hereby defined as flooding the work area with water to facilitate moisture content and compaction.

Section 309.05.03 Bedding - Bedding shall be placed in the trench in such a manner as to prevent the introduction of deleterious materials. The trench shall be cleared of all loose native soils, debris, trash, and water and the sand bedding spread in a smooth layer to the required depth. The bedding shall then be compacted to 95-percent relative density by the use of vibratory plate compaction equipment. The Contractor may use alternate equipment to achieve compaction subject to the prior approval of the Engineer. Such approval shall require the Contractor to demonstrate to the Engineer's satisfaction that the proposed method will achieve the required compaction without jeopardizing the integrity of the rest of the improvements being constructed.

After installing the pipe or structure, the Contractor shall place bedding material on both sides of the pipe to the springline. The bedding shall be thoroughly worked under the haunches of the pipe and hand tamped or compacted with a piston type compaction tool to achieve a 95-percent relative density. Care shall be taken to prevent displacing the pipe by placing more material on one side than the other. Care shall be taken to prevent dropping heavy loads of material directly on the pipe.

Before proceeding with the next lift of bedding, the material along the pipe shall be thoroughly tamped to achieve 95 percent relative compaction, taking care to prevent damage or displacement of the pipe. The material shall be compacted using a piston type compaction tool and hand tamping. Extra water may be used, above that necessary for optimum moisture content, to facilitate full bearing contact and compaction. Jetting and ponding will not be permitted.

Upon completion of placing and compacting bedding to the top of the pipe, sand bedding at the optimum moisture content shall be placed in one lift to a depth of 12-inches and spread uniformly throughout the trench. The bedding shall then be compacted by vibratory plate compaction equipment to a relative density of 95-percent. The Contractor may use alternate equipment to achieve compaction subject to the prior approval of the Engineer. Such approval shall require the Contractor to demonstrate to the Engineer's satisfaction that the proposed method will achieve the required compaction without jeopardizing the integrity of the rest of the improvements being constructed.

Section 309.05.03 Sand and Crushed Aggregate Backfill - After sand bedding has been brought to a depth of 12-inches over the pipe or the structure placed or constructed on the bedding, sand or crushed aggregate shall be placed in lifts not to exceed 8-inches in depth at the optimum moisture content and compacted by vibratory plate compaction equipment to a relative density of 95-percent. The Contractor may use alternate equipment to achieve compaction subject to the prior approval of the Engineer. Such approval shall require the Contractor to demonstrate

to the Engineer's satisfaction that the proposed method will achieve the required compaction without jeopardizing the integrity of the rest of the improvements being constructed. Each lift shall be adequately compacted prior to placing the next lift of backfill. Backfill shall be brought to a minimum depth of 6-inches below the final paving surface. At the Contractor's option and subject to the approval of the Engineer.

Section 309.05.04 Native Backfill - Native backfill shall be constructed in the same manner as provided for in Section 309.05.03, "Sand and Crushed Aggregate Backfill" of these Standard Specifications. Except as provided for in the *Contract Documents*, native backfill shall be compacted to 90-percent relative density and continued to a depth of 6-inches above the surrounding ground surface. The Contractor shall install such erosion control measures as water bars and berms as are necessary to prevent erosion of the backfill surface. The surface shall then be seeded with a mix conforming with Santa Cruz County Erosion Control Mix or restore any landscaping to an equal or better condition than that found prior to commencing work.

Section 309.05.05 Sand/Cement Slurry Backfill - Where called for in the *Contract Documents* or when approved by the Engineer, sand/cement slurry backfill may be placed to the full depth of the trench without first constructing a sand bedding. In such cases, the pipe or structure shall be supported on blocks as provided for elsewhere in these Standard Specifications or the *Contract Documents*.

The trench shall be cleared of all debris, loose soils, trash, and other deleterious material immediately prior to placing the sand/cement slurry backfill.

The Contractor shall place an anchor of sand/cement slurry over the pipe at intervals not to exceed 10-feet to prevent floating the pipe. Sand/cement slurry shall then be placed in such a manner as to ensure full contact with the pipe or structure and complete filling of all void spaces under the pipe or structure. The sand/cement slurry shall be shovelled and rodded until there is evidence that the void is filled. After placing either sand bedding or sand/cement slurry bedding, as provided for in the *Contract Documents* or approved by the Engineer, the Contractor shall place the sand/cement slurry backfill in the trench or excavation.

The trench or excavation shall be filled to the surface less the thickness of the final paving surface in one continuous operation. The sand/cement slurry shall be shovelled and rodded to ensure full contact with the walls of the trench or excavation. At the Contractor's option and subject to the approval of the Engineer, the sand/cement slurry may be brought to the surface and then excavated later to permit placement of the final paving surface.

Upon completion of backfilling operations, the Contractor shall place steel plates over the trench or excavation for a minimum period of 24-hours or that time provided for in the *Contract Documents*. The plates shall be fabricated of steel conforming with ASTM A36 and a minimum of 1-inch thick and capable of supporting an H20-S44 traffic load. The plates shall extend a minimum of 2-feet on each side of the trench or excavation. The plates shall be so placed as to prevent rocking or displacement due to traffic and the edges shall be sealed with cold-mix asphalt paving material in accordance with Section 310, "Paving" of these Standard Specifications. The cold mix shall be so placed as to provide a smooth transition on to and off of the plates.

The Contractor shall protect the sand/cement slurry surface from damage due to traffic, construction operations, and weather until such time as the final paving may be constructed.

Section 309.05.06 Aggregate Base - Upon completion of backfilling operations, the Contractor shall construct an aggregate base to a minimum depth of 8-inches below the underside of the final paving surface or that depth called for in the *Contract Documents*. In no case shall the depth of aggregate base be less than that of the existing pavement section. The Contractor shall protect the aggregate base surface from damage due to traffic, construction operations, and weather until such time as the final paving may be constructed.

Section 309.06 Measurement - Except as provided for in the *Contract Documents*, bedding, backfill, and aggregate base shall be considered as incidental to other items of work and will not be measured independently.

Where provided for to be paid as a contract pay item in the *Contract Documents*, quantities of bedding and backfill shall be calculated to the minimum neat line dimensions of the trench or excavation less pipe or structures called for

in these Standard Specifications or the *Contract Documents*. All such quantities will be measured and paid for by the cubic yard to the nearest ¼-cubic yard.

Quantities of bedding, backfill, and aggregate base to be paid for by the cubic yard will be calculated on the basis of the minimum neat line dimensions provided for in the *Contract Documents* adjusted by the amount of any change ordered by the Engineer. No allowance will be made for quantities of bedding, backfill, and aggregate base placed outside such dimensions except as otherwise provided for in the *Contract Documents*.

Where it is provided for in the *Contract Documents* or agreed to by the Engineer and the Contractor by *Contract Change Order*, quantities of bedding and backfill may be measured in transport vehicles or stockpiles. No such measurement will be made without the direct assistance of the Contractor and an agreement as to quantity so measured shall be made at the time of measurement. No change in the agreed to quantities will be considered after the time of measurement.

When it is provided in the *Contract Documents* that the unit of measurement is to be by the cubic yard, the final quantity paid for based on loose volume measurement shall be that difference in volume measured before and after incorporation in the work with an allowance of _ for loose bulking.

Section 309.07 Payment - Where provided for to be paid as a contract item in the *Contract Documents*, the contract unit price for bedding, backfill, or aggregate base shall include full compensation for providing all materials and doing all work involved in placing bedding, backfill, or aggregate base including but not limited to, transportation, placement, moisture conditioning, and compaction, as provided for in the *Contract Documents* and in these Standard Specifications.

Where not provided to be paid as a contract item in the *Contract Documents*, all costs associated with bedding, backfill, or aggregate base shall be considered as incidental to and included in the contract unit or lump sum prices bid for other items of work and no additional compensation will be allowed therefor.

SECTION 310 PAVING

Section 310.01 Description - The Contractor shall pave or repave all road surfaces within public Right-of -Ways, private right-of-ways, driveways, drainage courses, and other surfaces as provided for in the *Contract Documents*. Except as provided for in the *Contract Documents*, all paving materials shall be constructed of asphalt concrete or an asphaltic emulsion, with or without aggregate.

Section 310.02 Asphalt Concrete Pavement

Section 310.02.01 General - Asphalt concrete pavement shall be in accordance with the provisions of Section 39, "Asphalt Concrete" of the State Standard Specifications and these Standard Specifications. Except as provided for in the *Contract Documents*, a Certificate of Compliance in accordance with Section 106.40, "Certificates of Compliance" of these Standard Specifications shall be submitted in lieu of the testing and reporting requirements of the State Standard Specifications.

Section 310.02.02 Aggregate - Except as provided for in the *Contract Documents*, all asphalt concrete used in the construction of asphalt concrete pavements shall be Type "B" meeting the gradation requirements for ½-inch maximum, medium of Section 39-2.02, "Aggregate" of the State Standard Specifications.

Section 310.02.03 Asphalt Binder - Asphalt binder for asphalt concrete shall be a steam refined asphalt, Grade AR4000, conforming with the requirements of Section 92, "Asphalts" of the State Standard Specifications. The percentage of asphalt binder in asphalt concrete pavement shall be between 5-½ percent and 6 percent by weight.

Section 310.03 Cold-Mix Asphalt Concrete

Section 310.03.01 General - Cold-mix asphalt concrete used in temporary paving applications shall be a plant mixed product conforming with the requirements of this Section 310.03. Cold-mix may be supplied directly from the batch plant or stockpiled on the job-site.

Section 310.03.02 Aggregate - Aggregate shall meet the following gradation requirements:

Sieve Size	Percentage Passing
½-inch	100
_- inch	95-100
No. 4	58-72
No. 8	34-48
Nº. 30	18-32
Nº. 50	13-23
Nº. 200	2-9

Section 310.03.03 Asphalt Binder - Asphalt binder for cold-mix asphalt shall be Type SC-800 in accordance with the requirements of Section 93, "Liquid Asphalts" of the State Specifications. The percentage of asphalt binder shall be between 4.8 and 7.5 percent.

Section 310.04 Paint Binder and Prime Coat

Section 310.04.01 General - Paint binder (tack coat) shall be applied to the vertical surface of all structures to which new asphalt concrete will abut. Additionally, where the *Contract Documents* provide for the placement of new asphalt concrete over existing pavement surfaces, a tack coat shall be applied to the surface of the old pavement. Where called for in the *Contract Documents*, the surface of aggregate base shall receive a prime coat of liquid asphalt immediately prior to commencing paving operations.

Section 310.04.02 Paint Binder (Tack Coat) - Paint binder shall be Type RS-1 asphaltic emulsion conforming with the provisions of Section 94, "Asphaltic Emulsions" of the State Standard Specifications.

Section 310.04.03 Prime Coat - Prime coat shall be Type SC-70 liquid asphalt conforming with the provisions of Section 93, "Liquid Asphalts" of the State Standard Specifications.

Section 310.05 Miscellaneous Areas

Section 310.05.01 General - Miscellaneous areas shall be those areas or structures called for in the *Contract Documents* to be surfaced or constructed of asphalt concrete. Such areas shall include but not be limited to, drainage ditches, equipment pads, walkways, and asphalt dikes.

Section 310.05.02 Materials - The gradation of aggregate for surfacing of miscellaneous areas shall be in accordance with Section 310.02, "Asphalt Concrete" of these Standard Specifications. The percentage of asphalt binder shall be increased by 1-percent by weight over that percentage for asphalt concrete placed in roadways.

Section 310.05.03 Asphalt Dikes - Asphalt dikes shall be constructed to the line and grade provided for in the *Contract Documents*. Asphalt dikes whose continuous length exceeds 5 linear feet shall be constructed by the use of an extrusion machine.

Section 310.06 Construction - Upon completion of all pipe construction, including but not limited to trench backfill and aggregate base, the Contractor shall construct the final asphalt concrete surface. Such asphalt concrete surface shall be of the same depth, or greater, as the existing surface material. In no case shall the new asphalt concrete be less than 2-inches in depth.

All valve boxes, manholes, monument boxes, and other adjustable structures shall be brought to grade prior to placing the final lift of asphalt concrete. Where the distance between the edge of the new pavement and the existing edge of pavement, existing curb or gutter lip, or asphalt dike is less than 2 linear feet, the existing pavement shall be removed and replaced to the edge of pavement, existing curb or gutter lip or asphalt dike.

All temporary paving material, loose aggregate base, and other deleterious material shall be removed from the trench

line. As directed by the Engineer, a final pass shall be made with compaction equipment to ensure full compaction of the underlying surface. The surface of the aggregate base or sand cement slurry backfill and all abutting surfaces shall be prepared by spraying with a paint binder at a rate of 0.25 gallons per square yard. The Contractor shall prevent overspray onto adjacent pavement surfaces and other surfaces not scheduled to be paved. Paint binder shall not be tracked out of the trench line by vehicles or equipment.

Hot asphalt concrete shall be placed in the area to be paved and compacted by the use of rollers or vibratory plate type compaction equipment. The use of vibratory plate compaction equipment shall be limited to projects whose area totals less than 100 square feet and those areas on other projects where insufficient space is available for the operation of vibratory rollers. All spreading and compacting operations shall be in accordance with the provisions of Section 39, "Asphalt Concrete" of the State Standard Specifications except that tolerances will be measured by the use of a straight edge of sufficient length to span the full width of the trench plus 2-feet on each side of the trench line.

If the total depth of asphalt paving exceeds 2-½ inches, the asphalt shall be laid in a minimum of 2 lifts with the maximum lift equaling 2-½ inches. The minimum thickness of any lift of asphalt concrete shall be equal to twice the maximum size aggregate in the asphalt concrete mix. Each lift shall be fully compacted and finished prior to placing the next lift except that the grade tolerances shall apply for the final lift only.

All new asphalt concrete surfaces shall be abutted to adjoining surfaces along a neat sawcut line. In no case shall new asphalt be feathered over existing surface material, placed against damaged surfaces, or over or against any material not adequately prepared as defined herein. The final surface of the asphalt concrete shall be no more than _-inches above the adjacent existing surface nor shall the final surface be below the level of the adjacent surface. In areas of paving other than trench repairs, the plane of the surface shall not vary more than _-inches above or below the average plane of the surface when measured with an 8-foot straight edge.

Skin patching shall not be considered an acceptable method of achieving the tolerances herein. Skin patching is hereby defined as a mix of asphaltic concrete whose maximum aggregate size is less than or equal to the No. 4 sieve used to fill depressions in the pavement plane.

The final lift of asphalt concrete shall be placed in one continuous operation as the final order of work for the project. Where trenches do not form an unbroken line throughout the project, asphalt concrete may be placed in one continuous operation for each continuous trench, subject to the prior approval of the Engineer.

All paving not conforming with the provisions of these Standard Specifications, the *Contract Documents*, or any public agency having jurisdiction over the work shall be immediately removed and replaced in accordance with the provisions of these Standard Specifications, the *Contract Documents*, and the directions of such agencies having jurisdiction over the work.

Section 310.07 Measurement

Section 310.07.01 Trench Repairs - Except as provided for in the *Contract Documents*, the costs associated with all asphalt concrete and other asphaltic products as part of trench repair or reconstruction shall be considered as included in the contract unit or lump sum prices for other items of work and no additional compensation will be allowed therefor.

Section 310.07.02 Miscellaneous Areas - Except as provided for in the Contract Documents, the costs of all asphalt concrete and other asphaltic products used in the construction of miscellaneous areas shall be considered as included in the contract unit or lump sum prices for the construction of such miscellaneous areas and no additional compensation will be allowed therefor.

Section 310.07.03 Measurement by Area - Where provided for in the *Contract Documents*, asphalt concrete will be paid for by the square yard. The total area shall be calculated to the minimum neat line dimension of the improvements as provided for in the *Contract Documents* or as approved by the Engineer. Measurements of square yardage of asphalt concrete surfaces shall be measured to the nearest 0.1 square yard.

Section 310.07.04 Measurement by Weight - Where provided for in the *Contract Documents*, asphalt concrete will be paid for by the ton. The tonnage to be paid for shall be calculated to the minimum neat line dimensions of the surface being paved, to the depth provided for in the *Contract Documents* or agreed to by the Engineer and Contractor. The tonnage of asphalt concrete per inch of compacted thickness shall be as follows:

Asphalt Concrete Spread Rate		
Depth (inches)	**Square Yards per Ton**	**Tons per Square Yard**
1	17.64	0.057
1-½	11.76	0.085
2	8.82	0.113
2-½	7.35	0.142
3	5.88	0.170
4	4.41	0.227
5	3.53	0.284
6	2.94	0.340

Section 310.08 Payment - Where provided to be paid as a separate pay item, the contract unit price per ton or per square yard for asphalt concrete shall include full compensation for all labor, materials, equipment, and tools and for doing all work required in constructing asphalt concrete pavement including but not limited to, sawcutting and removing existing pavement, preparation of the underlying surface, tack coat, prime coat, hauling, traffic control, spreading, and compacting complete in place as provided for in the *Contract Documents*, as provided for in these Standard Specifications, and as directed by the Engineer and no additional compensation will be allowed therefor.

SECTION 311 FOG SEAL

Section 311.01 Description - Where provided for in the Contract Documents, the Contractor shall apply a fog seal that covers the repaved trench section and the adjacent street pavement. The Engineer shall determine the limits of the fog seal application. Such fog seal shall be constructed in accordance with the provisions fo Section 37-1, "Seal Coats" of the State Standard Specifications. The exact proportion of water to asphaltic emulsion shall be determined by the Contractor up to a maximum of one part water to one part asphaltic emulsion.

Section 311.02 Measurement

Section 311.02.01 Trench Repairs - Except as provided for in the *Contract Documents*, the costs associated with fog seal application as part of trench repair or reconstruction shall be considered as included in the contract unit or lump sum prices for other items of work and no additional compensation will be allowed therefor.

Section 311.02.02 Miscellaneous Areas - Except as provided for in the Contract Documents, the costs of fog seal application used in the construction of miscellaneous areas shall be considered as included in the contract unit or lump sum prices for the construction of such miscellaneous areas and no additional compensation will be allowed therefor.

Section 311.02.03 Measurement by Area - Where provided for in the *Contract Documents*, fog seal application will be paid for by the square yard. The total area shall be calculated to the minimum neat line dimension of the

improvements as provided for in the *Contract Documents* or as approved by the Engineer. Measurements of square yardage of fog seal shall be measured to the nearest 0.1 square yard.

Section 311.03 Payment - Where provided to be paid as a separate pay item, the contract unit price per square yard for fog seal shall include full compensation for all labor, materials, equipment, and tools and for doing all work required in applying fog seal including but not limited to, preparation of the underlying surface, hauling, traffic control and applying fog seal complete in place as provided for in the *Contract Documents*, as provided for in these Standard Specifications, and as directed by the Engineer and no additional compensation will be allowed therefor.

SECTION 312 SEAL COAT

Section 312.01 Description - Where provided for in the Contract Documents, the Contractor shall construct a seal coat of asphaltic emulsion and screenings that covers the repaved trench section and the adjacent street pavement. The Engineer shall determine the limits of the seal coat application. Such seal coat shall be constructed in accordance with the provisions fo Section 37-1, "Seal Coats" of the State Standard Specifications for a double seal coat. A Certificate of Compliance shall be submitted for all materials used in constructing the double seal coat.

Section 312.02 Measurement

Section 312.02.01 Trench Repairs - Except as provided for in the *Contract Documents*, the costs associated with constructing a double seal coat as part of trench repair or reconstruction shall be considered as included in the contract unit or lump sum prices for other items of work and no additional compensation will be allowed therefor.

Section 312.02.02 Miscellaneous Areas - Except as provided for in the Contract Documents, the costs associated with constructing a double seal coat used in the construction of miscellaneous areas shall be considered as included in the contract unit or lump sum prices for the construction of such miscellaneous areas and no additional compensation will be allowed therefor.

Section 312.02.03 Measurement by Area - Where provided for in the *Contract Documents*, the construction of a double seal coat will be paid for by the square yard. The total area shall be calculated to the minimum neat line dimension of the improvements as provided for in the *Contract Documents* or as approved by the Engineer. Measurements of square yardage of double seal coat shall be measured to the nearest 0.1 square yard.

Section 312.03 Payment - Where provided to be paid as a separate pay item, the contract unit price per square yard for double seal coat shall include full compensation for all labor, materials, equipment, and tools and for doing all work required in constructing a double seal coat including but not limited to, preparation of the underlying surface, hauling, sweeping, and traffic control necessary to construct the double seal coat complete in place as provided for in the *Contract Documents*, as provided for in these Standard Specifications, and as directed by the Engineer and no additional compensation will be allowed therefor.

SECTION 313 CHAIN LINK FENCING

Section 313.01 Description - Where provided for in the *Contract Document*s, the Contractor shall construct a chain-link fence at the locations and of the dimensions provided for. Such fencing shall be accordance with these specifications, Standard Plan No. S-5, "6-Foot Chain Link Fence", and in general conformance with Section 80, "Fences" of the State Standard Specifications.

Section 313.02 Materials

Section 313.02.01 Posts and Rails - All posts shall be fabricated from Schedule 40 galvanized iron pipe conforming with the provisions of Section 302.05, "Iron Service Piping" of these Standard Specifications. Each gate post and each line post not having a barbed wire support shall be equipped with a standard fence post cap.

Section 303.02.02 Fabric - Chain link fence fabric shall be steel wire heliacally wound and interwoven in such a manner as to result in a continuous mesh with no knots or ties except in forming the selvage of the fabric. The base

material of the wire shall be galvanized No. 9 AWG. Where provided for in the Contract Documents, the fabric shall be furnished with redwood slats interwoven in the fabric in a vertical direction.

Section 313.02.03 Gate Hinges and Latches - Each gate shall be equipped with a minimum of 2 heavy-duty pintle type hinges. One leaf of the gate shall be equipped with a gate fork type of latch manufactured of heavy-duty galvanized malleable iron and equipped with a padlock hole. The inactive leaf shall be equipped with a heavy-duty cane-type assembly that seats in a galvanized steel pipe set a minimum 12-inches in the underlying material. This pipe shall be surrounded by a collar of Class B portland cement concrete at least 6-inches thick and 12-inches in diameter.

Section 313.02.04 Barbed Wire - Barbed wire atop fences shall be a minimum of No. 14 AWG galvanized. Barbed wire supports shall be so designed as to be securely fastened to the post top and support the wire in position and angle provided for in the standard plan and the *Contract Documents*. The supports shall be capable of withstanding a 250-pound load applied at the end without deflection.

Section 313.03 Construction

Section 313.03.01 General - All chain link fencing shall be constructed within 6-inches and on the District side of all property lines except as provided for in the *Contract Documents*. Except as provided for in the *Contract Documents*, fences shall provide a minimum of 18-inches clearance to all structures.

Section 313.03.01 Fence Posts - Fence posts shall be set in neatly drilled holes and backfilled with Class B portland cement concrete. Holes shall be a minimum of 6-inches greater diameter than the post. Fence posts set in retaining walls shall be constructed by the use of a 4-inch diameter PVC pipe sleeve in the wall. The annular space between the post and the pipe wall shall be filled with a cementious grout. Concrete and grout shall be struck off such that there is a minimum of ¼-inch fall across the finish surface. No constrution of fence elements shall commence until the concrete or grout has been allowed to cure a minimum of 3-days.

Section 313.03.02 Truss Rods and Brace Rails - At each corner post, a _-inch truss rod with tightener shall be installed between the corner post and the first line post each direction. A 1-¼ inch O.D. brace rail shall be installed across each intersecting panel Crossed truss rods shall be installed across the two panels on either side of the gates and across the gate panels. A 1-¼ inch O.D. brace rail shall be installed across each adjacent panel. The bottom rail shall be located 2-inches above the final grade of the site at the line of the fence.

Section 313.03.03 Gates - Gates shall be constructed of the same materials used in the overall fence. Corners and brace rails shall be assembled using manufactured fittings or by shop welding. Any welding shall be galvanized after fabrication by either the hot-dip process or the "hot-stick" application of metallic zinc. Manway gates shall not be required to have truss rods. The latch shall be secured to the gate frame by either tack welding or pinning such that it cannot be dislodged from the original position.

Section 313.03.04 Fabric - Fabric shall be secured to the top and bottom rails and any brace rails at 24-inch intervals using No. 9 AWG galvanized tie wire. Fabric shall also be secured to all posts with No. 9 AWG galvanized tie wire. At each corner or gate the fabric shall be secured to the posts using a ¼-inch by ¾-inch galvanized steel tension bar. The tension bar shall be secured to the post by the use of 1-inch by 11-guage galvanized steel strap at 12-inches on center vertically. All fabric shall be installed on the outside of all posts and rails with respect to the District property.

Fabric shall be stretched taut using any tensioning device or method that will accomplish the tensioning without distorting the fabric. The Contractor shall be responsible for the method selected.

Section 313.04 Measurement and Payment - The contract unit price per linear foot for 6-foot Chain Link Fence shall include full compensation for all labor, materials, equipment, and tools and for doing all work required in constructing a chain link fence including but not limited to, clearing and leveling of the underlying surface, installing fence posts, fabric, gates, and hardware necessary to construct the chain link fence complete in place as provided for in the *Contract Documents*, as provided for in these Standard Specifications, and as directed by the Engineer and no

additional compensation will be allowed therefor.