

SECTION 50 - CONSTRUCTION MATERIALS

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SECTION 50 CONSTRUCTION MATERIALS

This Section indicates the requirements for various classes and types of materials used in construction. Materials not included in this Section shall be as described and specified in other Sections of these Specifications or in the Special Provisions.

50-1 PORTLAND CEMENT

Unless otherwise specified in the Special Provisions, all cement used in concrete shall conform to ASTM Designation: C 150, Type II.

Type III portland cement may be substituted for Type II when Special Provisions require high early strength.

All portland cements shall be "low alkali", containing not more than 0.60 percent by weight of alkalis, calculated as the percentage of Na_2O plus 0.658 times the percentage of K_2O .

Unless otherwise specified in the Special Provisions, calcium chloride shall not be used in any concrete containing steel reinforcement or other embedded metals.

When directed by the Agency, the Contractor shall furnish certificates of compliance stating that the cement delivered to the work complies with these Specifications.

50-2 CONCRETE AGGREGATES

Unless otherwise specified in the Special Provisions, concrete aggregates shall conform to ASTM Designation: C 33, except that grading requirements shall be as specified in Section 90-3, "Aggregate Gradings", of the State Specifications.

50-3 WATER FOR CONCRETE

Water used for mixing and curing concrete shall be clean, free from oil, acid, alkalis, vegetable matter, or other deleterious matter. No water containing excessive amounts of salts, sulfates, or chlorides shall be used.

50-4 PREMOULDED EXPANSION JOINT FILLER

Unless otherwise specified in the Special Provisions, premoulded expansion joint filler material shall conform to ASTM Designation: D 1751.

50-5 PORTLAND CEMENT CONCRETE

50-5.01 Composition

Portland cement concrete shall be composed of portland cement, fine aggregate, coarse aggregate, admixtures (if used) and water; and shall be designated as one of the following classes:

Class "A-1" Concrete—Shall contain six (6) sacks (564 pounds) of portland cement per cubic yard and shall have a maximum size of coarse aggregate of either one inch (1") or one and one-half inches (1-1/2").

Class "A-2" Concrete—Shall contain six (6) sacks (564 pounds) of portland cement per cubic yard and shall have a maximum size of coarse aggregate of three-quarters inch (3/4").

Class "B-1" Concrete—Shall contain five (5) sacks (470 pounds) of portland cement per cubic yard and shall have a maximum size of coarse aggregate of either one inch (1") or one and one-half inches (1-1/2").

Class "B-2" Concrete—Shall contain five (5) sacks (470 pounds) of portland cement per cubic yard and shall have a maximum size of coarse aggregate of three-quarters inch (3/4").

Class "C" Concrete—Shall contain four (4) sacks (376 pounds) of portland cement per cubic yard and shall have a maximum size of coarse aggregate of either one inch (1") or one and one-half inches (1-1/2").

Should the quantity of ingredients designed to produce a cubic yard of finished concrete result in a yield greater than one (1) cubic yard, the relative proportions of fine and coarse aggregates shall be adjusted as necessary to maintain a consistent quantity of portland cement in each cubic yard of concrete.

A mix design for each class of portland cement concrete used in the Work shall be submitted to the Agency for approval at least seven (7) days prior to the proposed portland cement concrete being incorporated into the Work.

50-5.02 Proportioning

The Contractor shall determine the mix proportions for all portland cement concrete to be used in the Work. The coarse and fine aggregates shall be combined in such proportions that the percentage composition by weight of the individual and primary aggregate sizes, as determined by laboratory screens and sieves, conforms to Section 90-3, "Aggregate Gradings", of the State Specifications.

Exact proportions of primary aggregate sizes used in the concrete mix shall be as designated or approved by the Agency. The Agency may adjust the mix to accommodate changes in aggregate and moisture contents, to improve mixing and placing characteristics and to secure maximum quality of the finished concrete.

50-5.03 Mixing

Concrete shall be from an approved plant. All concrete mixing shall be done in machine batch mixers of an approved type, having a capacity of not less than that which utilizes a full sack of cement, unless, in the opinion of the Agency, the quantity to be mixed is too small to justify the use of a batch mixer. Sacks of cement shall be completely emptied by dumping directly upon other materials previously measured into the mixer. No splitting of sacks of cement will be allowed. The cement may be weighed into the batch from bulk storage if the Contractor provides suitable equipment approved by the Agency.

Mixing shall continue for a minimum of one (1) minute. In mixers larger than one (1) cubic yard capacity the mixing time shall be increased so minimum mixing time is not less than one (1) minute for each cubic yard, or part thereof, of the mixer capacity. Where transit mixers are used, the mixing period shall conform to the requirements of ASTM Designation: C 94.

The total volume of material mixed per batch shall not exceed the rated capacity of the mixer as determined by the standard requirements of the Associated General Contractors of America. Mixing equipment not indicated in this Section shall be operated at the speeds recommended by the manufacturer. Revolving drum mixers, except on transit mixers, shall not make less than fourteen (14) nor more than eighteen (18) revolutions per minute. The rotation rate of transit mixers shall produce a peripheral speed of approximately two hundred (200) feet per minute.

Each paving mixer or stationary mixer shall be equipped with an acceptable timing device.

Should the Contractor elect to utilize transit-mixing equipment, the Contractor shall make adequate advance arrangements for preventing delays in delivery and placing of the concrete. If there is an interval of more than forty-five (45) minutes between any two (2) consecutive

batches or loads, or a delivery and placing rate of less than eight (8) cubic yards of concrete per hour, the Agency may shut down the work for the remainder of the day. If the work is shut down, the Contractor, at the Contractor's expense, shall make a construction joint in the concrete already placed at the location and of the type directed by the Agency.

Transit-mixed concrete shall be delivered to the site of the Work and discharge shall be completed within ninety (90) minutes after the addition of the cement to the aggregates or before the drum has been revolved two hundred fifty (250) revolutions, whichever comes first. In hot weather or under conditions contributing to quick stiffening of the concrete or when the temperature of the concrete is eighty-five degrees (85°) F or above, the time between the introduction of the cement to the aggregates and discharge shall not exceed forty-five (45) minutes.

Batch or transit-mixed concrete delivered to the Work shall be accompanied by a ticket showing the volume of the concrete, the weight of cement in pounds, and the total weight of all ingredients in pounds. The ticket shall also show the time of day the materials were batched.

The Agency may stop concrete pouring if the placing of the concrete is causing separation of constituent materials of the concrete.

Transporting of concrete in non-mixing trucks or trailers will not be permitted.

50-5.04 Water Control

Within the limits hereinafter specified, the amount of water required for the proper consistency of concrete shall be determined by the slump test, in accordance with ASTM Designation: C 143.

The Allowance for slump, unless otherwise directed by the Agency, shall be as follows:

Concrete paving and reinforced structures—Not more than three inches (3")

Reinforced structures and columns—Not more than four inches (4")

Concrete placed under water—Not less than six inches (6") nor more than eight inches (8")

No additional mixing water shall be incorporated into the concrete during hauling or after arrival at the delivery point, unless authorized by the Agency. If the Agency authorizes additional water to be incorporated into the concrete, the drum shall be revolved not less than thirty (30) revolutions at mixing speed after the water is added and before discharge is commenced.

If the concrete is mixed in transit, the control equipment shall be at the proportioning plant and there shall be no water added after the mixture leaves the plant, unless directed by the Agency.

The Contractor shall furnish, without charge, such materials as may be required for making tests of concrete during the progress of the Work. Such tests will be made at the Agency's expense.

50-6 CURING COMPOUNDS FOR CONCRETE

Concrete curing compounds shall be used where specified in these Specifications and the Special Provisions.

The compounds shall meet the requirements of Section 90-7.01B, "Curing Compound Method", of the State Specifications.

50-7 AGGREGATE BASES

Aggregate bases shall conform to the requirements of Section 26, "Aggregate Bases", of the State Specifications, and these Specifications.

The combined aggregate shall conform to the gradation requirements specified for the 3/4-inch maximum aggregate for Class 2 aggregate base, unless otherwise specified in the Special Provisions.

50-8 PIT RUN BASE (GRADED)

Pit run base is a processed pit run material from local sources which may be specified on the Plans or in the Special Provisions for work where ordinary earth fill may not be satisfactory.

Pit run material shall have a minimum sand equivalent of 25, as determined by California Test Method 217.

Pit run base shall have the following limits of gradation:

<u>Sieve Size</u>	<u>Percentage Passing</u>
2-1/2"	100
2"	75-100
1"	50-75
No.4	20-50
No. 200	0-10

50-9 COBBLES

Cobbles shall measure a minimum four inches (4") in the least dimension and a maximum of twelve inches (12") in the greatest dimension.

50-10 GEOTEXTILE FABRIC

The geotextile shall be of nonwoven construction and consist of long-chain polymeric fibers composed of polypropylene, polyethylene, or polyamide. The fibers shall be oriented into a random web and stabilized so they retain their relative positions. The geotextile shall be free of any chemical treatment or coating which reduces permeability and shall be inert to chemicals commonly found in soil.

The geotextile shall conform to the physical property requirements listed in the table below:

TABLE 50-1 REQUIRED GEOTEXTILE PROPERTIES		
Physical Property	Test Method	Acceptable Minimum Test Results
Tensile strength, lb	ASTM D 1682	120
Elongation, %	ASTM D 1682	60
Coefficient of water permeability, cm/sec	ASTM D 4491	0.10
Puncture strength, lb	ASTM D 7511	65
Mullen Burst strength, psi	ASTM D 3786	215
Note: Tension testing machine with ring clamp, steel ball replaced with a 5/16-inch-diameter solid steel cylinder, with flat tip and beveled edges, centered within the ring clamp.		

Supac 4NP as manufactured by Phillips Fibers Corporation meets these specifications.

50-11 CEMENT-TREATED BASES

Road-mixed and plant-mixed cement treated base shall comply with Section 27, “Cement Treated Bases”, of the State Specifications.

50-12 LIME TREATED BASE

Lime treated base shall be constructed by mixing lime and water with existing subgrade materials. The lime to be mixed with the existing materials shall be a commercial hydrated lime conforming to the requirements of ASTM Designation: C 51. When sampled by the Agency at the point of delivery, the sample of hydrated lime shall contain not less than eighty-five percent (85%) of calcium hydroxide as determined by California Test Method 414.

A Certificate of Compliance and certified weight slips for each delivery shall be submitted to the Agency.

50-13 SAND

50-13.01 River Sand

River sand shall be free from vegetable matter, lumps, balls of clay, or adherent films of clay. The material shall not have more than twenty percent (20%) passing a two hundred (200) mesh screen.

50-13.02 Graded Sand

Graded sand shall be free from vegetable matter, lumps, balls of clay, or adherent films of clay. The percentage composition by weight of graded sand shall conform to the following gradations:

<u>Sieve Size</u>	<u>Percentage Passing by Weight</u>
9.5 mm (3/8")	100
4.75 mm (#4)	95-100
2.36 mm (#8)	90-100
1.18 mm (#16)	80-100
600 µm (#30)	65-100
300 µm (#50)	40-70
150 µm (#100)	0-30
75 µm (#200)	0-12

50-14 CRUSHED ROCK

A uniformly graded material that is the product of crushing rock or gravel, free of organic matter, oil, alkali, or other deleterious substances, and is hard, sound and durable.

Unless otherwise specified in the Special Provisions, crushed rock shall conform to the requirements for coarse (1/2" x No. 4) crushed screenings as specified in Section 37-1.02, “Materials”, of the State Specifications, and these Specifications. Crushed rock shall have a minimum Cleanliness Value of 80 as determined by California Test Method 227.

Unless otherwise specified in the Special Provisions, sanitary sewer pipe bedding material shall be as detailed on Standard Drawing 7-4.

50-15 CONTROL DENSITY BACKFILL

Control density backfill material shall consist of a workable mixture of aggregate, cementitious materials, and water.

Prior to excavation, the Contractor shall submit to the Agency for approval a mix design, and test data that demonstrate that the mix design complies with the following:

- Portland cement shall be Type II conforming to the requirements in Section 50-1, "Portland Cement", in this Section of these Specifications.
- Admixtures, including mineral admixtures (pozzolan), may be used in conformance with Section 90-4, "Admixtures", of the State Specifications. Chemical admixtures containing chlorides such as Cl in excess of one percent (1%) by mass of admixture, as determined by California Test Method 415, shall not be used. The amount of air-entraining admixture added shall be a minimum of eight percent (8%) and a maximum of twenty percent (20%).
- Course aggregate shall consist of a well-graded mixture of crushed rock with a maximum size aggregate of three-eighths inch (3/8"). One hundred percent (100%) shall pass the one-half-inch (1/2") sieve. Not more than thirty percent (30%) shall be retained by the three-eighths inch (3/8") sieve and not more than twelve percent (12%) shall pass the No. 200 sieve. All material shall be free from organic matter and not contain more alkali, sulfates, or salts than the native materials at the site of work.
- The minimum twenty-eight-day (28-day) compressive strength shall be one hundred pounds per square inch (100 psi) and the maximum shall be two hundred pounds per square inch (200 psi).

Water shall conform to Section 50-3, "Water for Concrete", in this Section of these Specifications.

Materials for control density backfill shall be thoroughly machine-mixed in a pugmill, rotary drum, or other approved mixer. Mixing shall continue until the cementitious material and water are thoroughly mixed. Control density backfill shall be placed within ninety (90) minutes after introduction of the cement to the aggregates.

Control density backfill shall be placed in a uniform manner that will prevent voids in, or segregation of, the backfill. Foreign material that falls into the trench prior to or during placing of the control density backfill shall be immediately removed.

When control density backfill is to be placed within the traveled way or otherwise to be covered by paving, the material shall achieve a maximum indentation diameter of three inches (3") prior to covering and opening to traffic. Penetration resistance shall be as measured by ASTM Designation: C 6024.

50-16 CLEAN CRUSHED ROCK

Clean crushed rock of the type shown or specified in the Contract shall be the product of crushing rock or gravel. The percentage composition by weight of clean crushed rock shall conform to the following gradations for the Type specified:

Sieve Size	Type A (1/2" crushed)	Type B (3/4" crushed)	Type C (1" crushed)	Type D (1-1/2" crushed)
2"	--	--	--	100
1-1/2"	--	--	100	--
1"	--	100	90-100	--
3/4"	100	90-100	30-60	0-17
1/2"	90-100	30-60	0-20	--
3/8"	20-60	0-20	--	0-7
No.4	0-15	0-5	0-5	--
No.200	0-2	0-2	--	0-2

Clean crushed rock shall have a minimum Cleanliness Value of 60 as determined by California Test Method 227. The portion of the material which is retained on the three-eighths inch (3/8") sieve shall contain at least fifty percent (50%) of particles having three (3) or more fractured faces.

50-17 ASPHALT, LIQUID ASPHALT, AND ASPHALTIC EMULSION

Asphalt, liquid asphalt, and asphaltic emulsion, as required by these Specifications or by the Special Provisions, shall mean the asphalts as specified in Section 92, "Asphalts", of the State Specifications, liquid asphalts as specified in Section 93, "Liquid Asphalts", of the State Specifications, and asphaltic emulsions as specified in Section 94, "Asphaltic Emulsions", of the State Specifications.

50-18 VITRIFIED CLAY PIPE (VCP)

Vitrified clay pipe shall conform to the specifications for extra strength unglazed clay pipe in ASTM Designation: C 700 and shall conform to all materials data contained in the current Clay Pipe Engineering Manual published by the National Clay Pipe Institute. A Certificate of Compliance must be furnished by the pipe manufacturer.

Stoppers shall be used with unconnected branch pipes. Stoppers for branch pipes having flexible compression joints may either be factory-applied clay discs with flexible compression joints that will mate with the branch joint; a resilient material of controlled design and dimensions for mating with the branch pipe to which it is to be applied, or of other material approved by the Agency. Wooden stoppers will not be accepted.

Joints shall be factory applied resilient-type plastic compression type or banded rubber couplings and sleeves conforming to ASTM Designation: C 425.

50-19 SUBSURFACE DRAINS

Subsurface drains shall comply with Section 68, "Subsurface Drains", of the State Specifications.

50-20 NONREINFORCED CONCRETE PIPE (CP)

Nonreinforced concrete pipe shall conform to ASTM Designation: C 14.

50-21 REINFORCED CONCRETE PIPE, DRAINAGE (RCPD)

Reinforced concrete pipe shall conform to ASTM Designation: C 76 for Class I, II, III, IV, or V. The class of pipe will be shown on the Plans or specified in the Special Provisions.

Sections of circular pipe with elliptical reinforcing shall have the location of the minor axis of the reinforcing indicated by three-inch (3") wide, waterproof, painted stripes on the inside and outside of the pipe at the top and bottom, at least twelve inches (12") long at each end of the pipe section.

Unless otherwise indicated on the Plans or in the Special Provisions, joints for concrete pipe shall be bell and spigot and shall be of a design that, when properly laid, shall have a smooth and uniform interior surface. Each joint shall be sealed to prevent leakage. Unless otherwise indicated on the Plans or in the Special Provisions, joints shall be sealed with a rubber O-ring gasket conforming to ASTM C443. Compression couplings capable of the same performance are also allowed where splices are needed.

50-22 REINFORCED CONCRETE PIPE, SEWER (RCPS)

Reinforced concrete sewer pipe shall conform to ASTM Designation: C 76, "Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe", with the following exceptions, amendments, and additions:

Section 5, Basis of Acceptance.

Replace Section 5.1.1, "Acceptance on the Basis of Plant Load-Bearing Tests, Material Tests, and Inspection of Manufactured Pipe for Visual Defects and Imperfections", with:

Acceptance of pipe and materials shall be based on results obtained from the tests specified in Section 11 of ASTM Designation: C 76 as herein modified. Unless authorized in writing, only pipe marked at the plant by the Agency's representative will be acceptable.

Section 6, Materials.

Replace Section 6.2.1, "Cement", with:

Portland cement shall conform to Section 50-1, "Portland Cement", in this Section of these Specifications.

Replace Section 6.3, "Aggregates", with:

Aggregate shall be calcareous, unless otherwise specified, resulting in a concrete mix yielding a finished product with a total alkalinity equivalent (as CaCO₃) of at least eighty percent (80%) when tested in accordance with the procedure described herein.

Both coarse and fine aggregate, when tested for soundness by the sodium sulfate test (ASTM Designation: C 88) shall show a loss not exceeding eight percent (8%) at the end of five (5) cycles. Aggregate failing to comply with the above specified soundness requirements may be used in the Work if specifically approved by the Agency, provided it contains less than two percent (2%) of shale and other deleterious particles and shows a loss of not more than ten percent (10%) by the above specified test.

Petrographic analysis of the aggregate source shall be furnished by an approved laboratory specializing in this type of work. Recommendation as to the acceptability of the source shall be presented, particularly with regard to the potential reactivity, if any, of the aggregate and the permissible alkalinity content of the cement.

Coarse aggregate shall consist of clean, hard, dense, tough, and durable natural gravel, crushed gravel, or crushed rock. It shall be free from oil, organic matter, or other deleterious substances.

When tested for abrasion in accordance with the method described in ASTM Designation: C 131, the coarse aggregate shall show a percentage of wear not

exceeding the following limits, using the grading applicable to the coarse aggregate being used:

- 100 revolutions—15 percent
- 500 revolutions—50 percent

Aggregate that exceeds the fifty percent (50%) limit may be used provided it produces concrete of satisfactory strength, subject to approval of the Agency.

When sampled at the batching bin, coarse aggregate shall have a cleanness value of not less than 75 by California Test Method 227.

Fine aggregate shall be free from oil or other deleterious substances, and when tested in accordance with ASTM Designation: C 40, it shall show a color lighter than standard.

Coarse and fine aggregates shall be tested for reactivity in accordance with ASTM Designation: C 289 or ASTM Designation: C 227, and shall meet the "Innocuous Aggregate" requirement.

The testing of all aggregates, as specified above, shall be at the expense of the Contractor.

Section 7, Design.

Add to Section 7.2, "Modified and Special Designs":

Circumferential steel reinforcement shall have minimum cover of one and one-half inches (1-1/2") from the inside surface and shall have a minimum cover of one inch (1") from the outside surface of pipe except where additional cover is shown on the Plans. Conditions permitting less cover shall not apply to the above case.

Section 8, Reinforcement:

Add:

Steel area in bells shall conform to Table 2 of the USBR Specifications.

Section 9, Joints:

Replace entire section with:

The joints for the C76 reinforced concrete pipe shall be concrete joints of flared bell design and spigot ends with (a) contained O-ring neoprene gasket(s). The joints shall be of a single or double rubber gasket type. The joints shall be similar to the Joint Type R-4 of USBR, except that joints for reinforced concrete pipe to be jacked in place may be double rubber gasket design similar to Joint Type R-1 of USBR. Unless otherwise specified, no other type of joint will be acceptable.

Joints and gaskets shall conform to and meet all of the requirements of ASTM Designation: C 443, except as modified or otherwise restricted in these Specifications. Each gasket shall be confined in a groove on the spigot end of the pipe so that movement of the pipe or hydrostatic pressure cannot displace the gasket(s). When the joint is assembled, the gasket(s) shall be compressed to substantially fill the groove(s) and effect a watertight seal.

The joint assemblies shall be so formed and accurately manufactured that when the pipes are drawn together in the trenches, the pipe shall form a continuous watertight conduit with smooth and uniform interior surface and shall provide for

slight movements of any pipe in the pipeline due to expansion, contraction, settlement, or lateral displacement.

The shape and dimensions of the joint shall be such that it will be self-centering upon closure and so designed that the gasket will not be required to support the weight of the pipe. The rubber gasket shall be the sole element of the joint depended upon to provide watertightness. The ends of the pipe shall be placed at right angles to the longitudinal centerline of the pipe, except where a beveled end pipe for deflection up to five degrees (5°) is required. The ends of the pipe units shall be finished to regular smooth surfaces and no point on the surface of the spigot end of a pipe unit shall project beyond, or be more than one-fourth inch (1/4") short of the specified plane.

Section 10, Manufacture:

Add:

Pipe sections shall be made in nominal lengths of at least eight feet (8') except where shorter lengths are required to meet special conditions. Shorter lengths shall be used only where shown or accepted. To accommodate changes in alignment or curved alignments of the pipeline, pipe ends may be beveled. Pipe ends shall not be beveled more than five (5) degrees. Pipe shall be centrifugally spun, or vertically cast using a wet cast process utilizing inner and outer forms. Concrete with a minimum slump of two and one-half inches (2-1/2") shall be used for manufacture of the pipe using the vertical cast process.

Fittings may be fabricated from steel plate cement mortar-lined and coated, or from mitered end concrete pipe, provided the maximum angle of any miter cut is fifteen degrees (15°) and the maximum deflection for a mitered bend shall be thirty degrees (30°). Steel plate fitting shall conform to the dimensional requirements of AWWA C208 Table 2. Steel plate shall conform to AWWA C301. Minimum plate thickness shall be one-quarter inch (1/4") and shall be designed to limit deflection under full external design load to one percent (1%) of the diameter. Mortar lining and coating thicknesses shall be at least three-quarters inch (3/4"), except outlets less than ten inches (10") shall have three-eighths inch (3/8") thick lining. Cement mortar coating shall be reinforced with 2 by 4 by 13 gauge galvanized welded wire mesh of the sulfuring type. For noncentrifugally applied coating, the wire mesh shall be stud-welded to the cylinder. Bell adapters shall be fabricated from steel plate and shall be accurately dimensioned for a rubber gasket joint. Cement and aggregates for fittings shall be the same as specified for pipe.

Replace Section 10.2, "Curing", with:

Curing shall be in accordance with AWWA C302, Section 3.7, except: a) Curing by steam for vertically cast pipe may be interrupted once during the twenty-four (24) hour period in addition to a period sufficient to remove the forms or supporting rings, and b) the actual curing period by steam for centrifugally spun pipe, not including the delay period, may be reduced to a minimum of 12 hours or until a minimum cylinder compressive strength of 4,000 psi is attained.

Section 11, Physical Requirements

Add to Section 11.1, "Testing Specimens":

The Contractor shall perform all testing and retesting of materials covered in the Testing Schedule and as hereinafter specified as part of the Work. The above includes materials, labor, products, equipment, certificates, and reports. Before

use of materials and shipment of pipe, the Contractor shall furnish the Agency three certified copies of test results. Test results shall indicate the name and title of the person supervising the test, and the date of testing. The Agency shall be notified three days in advance of tests for pipe loading and pipe joints leakage, to enable the Agency to witness the testing.

Cored pipe shall be repaired by the Contractor as described in ASTM C 76 Section 13, Repairs.

In-plant inspection will be conducted by the Agency or a testing and inspection company employed by the Agency to determine conformance with these Specifications. Special attention will be given to the placement of reinforcement, manufacturing procedure, and curing. Dimensions and placement of reinforcement steel for completed pipe will be inspected by the Agency for compliance with approved design drawings and these Specifications. Testing by the Agency complements testing and quality control by the manufacturer, and does not replace manufacturer's quality control.

Replace Section 11.2, "Number and Type of Test Required for Various Delivery Schedules", with Table 50-2:

**TABLE 50-2
TESTING SCHEDULE FOR RCPS**

Item	Material	Test	Number Of Tests	Test Method (Standard)	When Tested
1	Cement	Compliance brand or source	Four for each	ASTM C150	Provide mill reports for duration of pipe manufacture
2	Cement	Percent alkali as specified	Same as Item 1	ASTM C114	Same as Item 1
3	Fine and coarse aggregate	Sodium sulfate soundness as specified	One for each 500 tons of pipe produced up to a maximum of four for each brand or source	ASTM C88	Before start of pipe manufacture and at 25%, 50% & 75% of pipe manufacture – or - before start of pipe manufacture and at every 500 tons of pipe produced
4	Fine and coarse aggregate	Petrographic analysis of aggregate source. Potential reactivity	One for each source Same as Item 1	ASTM C295	Before use of aggregates
5	Coarse aggregate	Abrasion	Same as Item 3	ASTM C131	Same as Item 3
6	Coarse aggregate	Cleanness	Same as Item 3	California Test Method No. 227	Same as Item 3
7	Fine aggregate	Impurities	Same as Item 3	ASTM C40	Same as Item 3
8	Joint gaskets	Compliance	Two for each pipe diameter, each gasket manufacturer, each order (certification with each shipment)	ASTM D412 ASTM D2240 ASTM D395 ASTM D573 ASTM D471 ASTM D1149 ASTM D1171	Before use of gaskets
9	Steel reinforcement	Compliance	One for each size of reinforcement	Per ASTM standard given in material spec.	Before use of material
10	Concrete	Compression	Minimum of 5 cylinders	ASTM C391 & ASTM C361	Before production for design acceptance
11	Concrete	Compression	Minimum of 5 for each day's production	ASTM C391 & ASTM C361	Before delivery of pipe
12	Concrete	Calcium carbonate equivalent	Minimum of 2 per day from different batches ²	See specs. for details	Before pipe delivery

TABLE 50-2
TESTING SCHEDULE FOR RCPS (continued)

Item	Material	Test	Number Of Tests	Test Method (Standard)	When Tested
13	Pipe	D-load to 0.01 crack or to 120% of design	Minimum 3 sections each design ³ . All sections must pass.	ASTM C497	Before production for design acceptance
14	Pipe	D-load to design strength	2% ⁴ each size & each design produced with minimum of 1 for each size, design, production plant and each week	ASTM C497	Before delivery
15	Pipe	Absorption	Same as Item 14 with a minimum of 1 each day ⁵	ASTM C497	Before delivery
16	Pipe & joints	Hydrostatic leakage test	Minimum of 1 assembled joint (2 pipe sections) for each size	ASTM C443	Before pipe production & after gasket testing
17	Pipe & joints	Hydrostatic leakage test	For each size test all of the first 10 pipes produced, test 5 of the next 10 pipes produced, thereafter test 2% of all pipes produced ^{6, 7}	See specs. for details	Before pipe delivery
18	Pipe	Bond	Same as Item 14 with a minimum of 1 set each day ⁷	See specs. for details	Before pipe delivery

Notes:

- 1 USBR alternative method for stiff consistency (0" slump) may be used.
- 2 Additional tests will be required if concrete mix or source of aggregates changes. Samples will be taken from concrete cylinders.
- 3 A change in design is defined as involving a change in pipe wall thickness or change in steel placement configuration. Change in steel area to meet D-load requirements shall not be construed to be a change in design for purposes of this test.
- 4 Change to 1% for vertically cast or spun pipe.
- 5 Once per week for vertically cast or spun pipe.
- 6 In case of a failure, testing frequency shall be increased to test all of the subsequent 10 pipes produced, and 5 of the next 10 pipes produced.
- 7 Not required for vertically cast or spun pipe.

Amend Section 11.9, "Absorption":

For Method A, change nine percent (9%) to seven percent (7%).

Add:

Calcium Carbonate Equivalent - Titration tests for Calcium Carbonate Equivalent Test shall be run on representative samples of the calcareous aggregate concrete to determine if it complies with the minimum requirements for total alkalinity of eighty percent (80%), expressed as CaCO₃. The tests shall be conducted by and at the cost of the Contractor.

The test specimen of concrete shall be analyzed seven (7) or more days after the date of concrete placement. The date of concrete placement as well as the date of testing shall be recorded. A representative specimen weighing least one kilogram shall be selected from the concrete cylinder broken to establish the seven-day compressive strength of the concrete. The sample shall be crushed until one hundred percent (100%) will pass a No. 4 screen. The sample shall be quartered to 125 grams and then dried in an oven for four (4) hours at a temperature of between one hundred (100) and one hundred ten (110) degrees Centigrade. After drying, the sample shall be ground so that it will all pass a 100-mesh screen.

About one (1) gram of the sample shall be weighed and placed into a five hundred (500) milliliter Erlenmeyer flask. Add one hundred (100) milliliters of water. Place a funnel in the neck of the flask to minimize spray losses, and slowly add forty (40) milliliters of standardized one normal hydrochloric acid. When effervescence has subsided, heat to the boiling point and boil for about one-half (1/2) minute. Cool, add fifty (50) to one hundred (100) milliliters of water, and titrate with standardized, carbonate-free, one normal NaOH solution.

The end point pH should be between 6.8 and 7.8. If the pH is first brought up to 7.8, it will sink to a lower value because of hydrolysis reactions in the mixture. More NaOH must be added until the pH stays above 6.8 for two (2) minutes, but not above 7.8. A pH meter equal to Orian Model 601 digital ioanalyzer (Cat. No. 34144-056) with combination electrode shall be used.

Calculate the net acid consumption in milliequivalents per gram, as follows:

$$\text{m.e./g.} = \frac{(\text{N of HC1} \times \text{ml of HC1}) - (\text{N of NaOH} \times \text{ml of NaOH})}{\text{Weight of sample in grams}}$$

Percentage calcium carbonate equivalent is five (5) x milliequivalents per gram.

Two (2) tests shall be run on each sample received, using the same ground and dried specimen for the source of material for each test. The results of each individual test shall be reported, but the final result of the sample of concrete shall be the average of the two (2) tests.

The nominal requirement for calcium carbonate equivalent shall be eighty percent (80%). The concrete will be considered acceptable if the average calcium carbonate equivalent for any period covering five (5) successive determinations (10 tests) is equal to or greater than eighty percent (80%) and if no individual determination is less than seventy-seven percent (77%). Once five (5) determinations have been run, the average for successive determinations

shall be a running average, obtained by adding each new determination while dropping the oldest. If the five (5)-determination average at any time falls below eighty percent (80%), the produced pipe shall be unacceptable on each day that the determination was below eighty percent (80%) but will be subject to acceptance by retesting. Similarly, if any single determination falls below seventy-seven percent (77%), regardless of the five (5)-determination average, the pipe produced on that day shall be unacceptable, subject to acceptance by retesting. The individual acceptance rules must be independently fulfilled. Rejection of pipe for any reason does not eliminate it from its proper inclusion in calculating each five (5)-determination average.

When any lot of pipe is declared unacceptable, the Contractor may cull the pipe, eliminating those sections the Contractor does not want to include as part of the Contract and suitably labeling them so that they will not be shipped to the job. Of the remainder, the Agency shall select three (3) representative sections from the pipe produced each day. The Contractor shall core drill a hole approximately two inches (2") in diameter through the interior wall to the depth of reinforcing of each selected section. These cores shall be crushed and tested for their calcium carbonate equivalent as specified. If the determinations on the three (3) cores representing one day's production average eighty percent (80%) or higher, the pipe produced on that day will be considered acceptable in respect to calcium carbonate equivalent; otherwise it will be considered unacceptable.

Hydrostatic Test - Hydrostatic tests on the pipe units shall be made by applying suitable bulkheads at each end of the pipe and filling the pipe with water. At the Contractor's option, the pipe may be soaked under a reduced pressure for a period of time not to exceed forty-eight (48) hours prior to testing.

Acceptance hydrostatic tests shall be made at fifteen pounds per square inch (15 psi) internal pressure. The pipe shall withstand the test pressure prescribed above for at least twenty (20) minutes without cracking and with no leakage appearing on the exterior surface. Moisture appearing on the surface of the pipe in the form of damp spots or beads adhering to the surface will not be considered as leakage. Slow forming beads of water that result in minor dripping which seal and dry up upon retesting of the individual pipe unit under the prescribed test pressure will be considered acceptable. At the Contractor's option, the pipe may be soaked under a reduced pressure prior to retesting. The maximum length of soaking after the initial test shall be ninety-six (96) hours.

Bond Test - Take one (1) one and one-half inch (1-1/2") core from near each end of the pipe and split the cores on the plane of the reinforcement steel. The Agency will make a visual judgment of the percent bond between the concrete and steel. A minimum of eighty-five percent (85%) bond for each cage shall be obtained. If any one core has less than eighty-five percent (85%) bond, two (2) additional pipes from the lot shall be tested as described. If the steel of any one of these cores has less than eighty-five percent (85%) bond, the entire lot will be rejected.

Section 14, Repairs:

Delete entire section and replace with:

Repairs shall be made in accordance with U.S. Bureau of Reclamation Concrete Manual, Eighth Edition, Chapter VII, Section 138, to insure the interior surface of

the pipe shall be free from honeycombing or roughness and presents a finished, smooth, uniform, continuous surface.

Defects identified in Section 11 of the USBR Specifications will result in rejection of the pipe. In addition, any breaks or defects in the gasket bearing area of either the bell or spigot shall not extend over more than twenty-four inches (24") or ten percent (10%), whichever is smaller, of the circumference of the pipe. If the accumulated damage is detrimental to the use of the pipe, it will be rejected.

Repairs of damage during manufacture shall be made immediately and prior to the curing period without delaying the curing. All repairs, except for epoxy repairs, shall be water-cured a minimum of ten (10) days. Air holes over three-sixteenths inch (3/16") in any dimension shall be filled and sacked when more than six (6) occur in any square foot of the pipe interior surface. There shall be no holes greater than one-eighth inch (1/8") in any dimension in the gasket-bearing area. The Agency may require testing of repaired joints. All holes over three-sixteenths inch (3/16") deep or over three-eighths inch (3/8") wide shall be patched.

Add a new Section:

Shop Drawings - The Contractor shall submit to the Agency design calculations and detailed shop drawings showing details of the wall thickness, pipe joint, joint gasket, and reinforcement for each pipe size, pipe class and fittings. These details shall include the type of cage(s), the location of the cage(s) in the pipe wall, the size and spacing of circumferential and longitudinal reinforcing steel, and the cross-sectional area of reinforcing steel in each cage per lineal foot of pipe. The gasket details shall include the diameter of the cross-section and the unstretched diameter and volume. Pipeline layout drawings shall include pipe numbers, where applicable, stationing, manhole and structure locations, and all other pertinent details required to construct the pipeline. No pipe manufacturing will be allowed prior to acceptance of the calculations and drawings by the Agency.

50-23 CONCRETE CYLINDER PIPE AND CEMENT MORTAR LINED AND COATED STEEL PIPE

Concrete cylinder pipe shall conform to Federal Specifications SS-P-381a and cement mortar lined and coated steel pipe shall conform to Federal Specifications SS-P-385a, each subject to the following modifications:

- a. Minimum steel cylinder thickness shall be 0.109 inch.
- b. Mortar coating shall provide a minimum of three-quarters inch (3/4") cover over all structural steel.
- c. Cement mortar lining shall be of Type II portland cement and shall be centrifugally applied. Minimum lining thickness shall be one-half inch (1/2"). The finished inside diameter of the lined pipe shall be the diameter shown on the plans and shall match the inside diameter of the adjoining pipe sections to within one percent (1%), or one-quarter inch (1/4"), whichever is greater.
- d. Pipe shall be Class 100, unless otherwise shown or specified in the Contract.
- e. Deflection of the pipe cross section shall be limited to one percent (1%) of the inside diameter when the pipe is placed under full external design load.
- f. Pipe sections of less than standard length may only be used with approval of the Agency.

Joints for concrete cylinder pipe and cement mortar lined and coated steel pipe shall be O-ring rubber gasket type with grout “diaper” finish, bolted flange type, “Dresser” or “Victaulic” couplings.

50-24 ACRYLONITRILE-BUTADIENE-STYRENE (ABS) PIPE

Four-inch (4”) and six-inch (6”) ABS gravity sewer pipe and fittings shall conform to ASTM Designation: D 2661.

Joints shall be solvent cemented. All Service connections shall be installed with "Tee" or "Wye" fittings. Saddles are not approved. When the sewer main is of a material other than ABS, the connection joint near the sewer main shall be made with a FERNCO flexible adapter; or an approved equivalent product as approved by the Agency.

50-25 DUCTILE IRON PIPE (DIP), AND CAST IRON PIPE AND DUCTILE IRON FITTINGS

Ductile iron pipe shall conform to ANSI A21.51 (AWWA C151) for a minimum working pressure of one hundred fifty (150) psi unless otherwise specified. Ductile iron casting shall conform to and be tested in accordance with ASTM Designation: A 536. Casting grade for pipe shall be 60-42-10. Laying length shall be the manufacturer’s standard length, normally eighteen feet (18’). Shorter lengths may be used for closures and proper location of special sections.

Except for gravity sanitary sewer, the interior surface of all ductile iron pipe shall be cement-mortar lined and seal coated in conformance with AWWA C104 and the exterior surface shall have a bituminous coating of either coal tar or asphalt base, approximately 1 mil thick or as directed by the Agency or specified in the Special Provisions.

For gravity sanitary sewers, coat interior of ductile iron pipe with 40 mil (minimum) of two-component polyisocyanate, polyol-cured urethane coating equivalent to Corropipe II manufactured by Madison Chemical Industries. Wrap ductile iron pipe with two wraps of 8-mil HDPE wrapping sleeve. Secure sleeve with 3 wraps of 10 mil HDPE tape, overlapping each wrap one-half tape width.

Fittings shall have push-on, mechanical joints or flanged ends. Four-inch (4”) through twelve-inch (12”) fittings shall be ductile iron, fittings larger than twelve inches (12”) shall be cast iron or ductile iron. All fittings shall conform to ANSI 21.10 (AWWA C110), ANSI 21.11 (AWWA C111), or AWWA C153 designed for a working pressure of two hundred fifty (250) or three hundred fifty (350) pounds per square inch (psi). Coating and lining requirements shall be the same as specified for the pipe.

Joints shall be push-on or mechanical type and shall conform to ANSI 21.11 (AWWA C111) with rubber gaskets unless otherwise specified. Gasket lubricant shall be minimum required plus ten percent (10%).

50-26 POLYVINYL CHLORIDE (PVC) PIPE FOR SEWERS AND DRAINAGE

50-26.01 PVC Gravity Sanitary Sewers

PVC gravity sewer pipe and fittings in sizes eight inches (8”) to fifteen inches (15”) in diameter shall conform to ASTM Designation: D 3034 and shall be SDR 26 with elastomeric gasket joints providing a watertight seal. Minimum pipe stiffness at five percent (5%) deflection shall be one hundred fifteen pounds per square inch (115 psi) according to ASTM Designation: D 2412.

All joints shall be integral wall bell and spigot end. All service connections shall be installed with "Tee" or "Wye" fittings, gaskets "Tee" saddles with stainless steel bands, or other approved tapping devices. Solvent welded "Wye" saddles are not approved.

All rubber rings shall conform to ASTM Designation: F 477.

50-26.02 Small PVC Pressure Sanitary Sewers

PVC pressure sanitary sewer and drainage pipe, four-inch (4") through twelve-inch (12") diameter sizes, shall have a maximum dimension ratio (DR) of 18 (minimum pressure Class 150), unless otherwise specified, and shall conform to AWWA Standard C900. Outside diameter shall be manufactured to cast iron pipe (CIP) equivalents. Pipe shall be furnished in minimum standard lengths of twenty feet (20').

50-26.03 Large PVC Pressure Sanitary Sewers

PVC pressure sanitary sewer and drainage pipe fifteen-inch (15") through forty-eight inch (48") diameter shall have a maximum dimension ratio (DR) of 25 (minimum pressure 165), unless otherwise specified, and shall conform to AWWA Standard C905. Outside diameter (OD) pipe dimensions shall be manufactured to cast iron pipe equivalents. Pipe shall be furnished in minimum standard lengths of twenty feet (20').

Polyvinyl chloride pipe shall have integral wall-thickened bell ends designed for joint assembly using elastomeric gasket seals. The minimum wall thickness of the integral wall-thickened bell, at any point between the ring groove and the pipe barrel, shall conform to the DR requirements for the pipe barrel. The minimum wall thickness in the ring-groove and bell-entry sections shall equal or exceed the minimum wall thickness of the pipe barrel. The elastomeric gasket seals shall conform to ASTM Designation: F 477.

The pipe shall have a pipe stop indicated on the barrel that will accurately position the pipe end within the joint. The pipe in place shall permit thermal expansion and contraction of the pipe ends.

50-26.04 PVC Pipe for Drainage

Polyvinyl Chloride Pipe for drainage shall conform to one of the following Standards:

Diameter (inches)	Standard Designation
12	ASTM D3034, SDR 35; AWWA C900, DR 18
14	AWWA C 905, DR 18
15	ASTM D3034, SDR 35; AWWA C905, DR 18
16	AWWA C905, DR 18
18	ASTM D2241, SDR 51; AWWA C905, DR 18
20	AWWA C905, DR 18
21	ASTM D2241, SDR 51
24	ASTM D2241, SDR 51; AWWA C905, DR 18
27	ASTM D2241, SDR 51
30	AWWA C905, DR 18

Joints of PVC pipe shall consist of either an elastomeric gasket coupling or an integral bell and spigot with an elastomeric gasket. The assembly of joints shall be in accordance with the pipe manufacturer's recommendations and the requirements of ASTM Designation: D 3212.

The quality of material and installation of all PVC pipe shall meet or exceed the requirements of Section 38-10, "Testing of Pipe", of these Specifications.

Use of PVC pipe downstream of the last manhole or junction structure to an open channel, detention facilities or a daylight condition is not allowed.

50-27 CORRUGATED STEEL PIPE (CSP)

Corrugated steel pipe shall conform to the material and fabrication methods of Section 66, "Corrugated Metal Pipe", of the State Specifications, except as modified in these Specifications. Corrugated steel pipe shall only be used when specified in the Special Provisions. All corrugated steel pipe shall be fabricated with helical corrugations and with a continuous lock or weld seam extending from end to end of each length of pipe. Steel shall be zinc coated unless otherwise specified. Helically corrugated steel pipe shall be fabricated using corrugation profiles as shown in the following table:

TABLE 50-3 CORRUGATION PROFILE			
Diameter (Inches)	Normal Pitch (Inches)	Maximum Pitch (Inches)	Minimum Depth (Inches)
8 and 10	1-1/2	1-7/8	1/4
12 through 96	2-2/3	2-3/4	1/2
48 through 120	3	3-1/4	1
Note: The corrugation profile of 2-2/3" x 1/2" shall be used for all pipes from twelve-inch (12") through ninety-six-inch (96") diameter, unless otherwise shown on or specified in the Contract.			

Lock or welded seams shall develop the full strength of the pipe in accordance with the herein referenced Specifications.

Pipe that has been patched will be rejected.

When shown or specified in the Contract, the pipe, couplings, and fittings shall be protected with a bituminous coating as specified in Section 66-1.03, "Protective Coating, Linings and Pavings", of the State Specifications.

Corrugated steel products shall be shipped, handled, and placed in such a manner as to prevent scaling, bruising, or breaking of the galvanized surface or protective coating.

Couplings for corrugated steel pipe shall be of durable gasket design. Couplings shall consist of galvanized steel coupling bands fitted with gaskets fabricated from neoprene or butyl rubber or other durable resilient material approved by the Agency, and assembled in such a manner as to form a sealed joint. The Agency may require that the coupling design be submitted for approval prior to placing, and may require supporting data showing that the coupling is tight and durable. Heat-shrinkable plastic couplings will not be permitted.

Corrugated steel pipe fittings shall be constructed of the thickness of steel shown on the Plans.

The fittings shall conform to the details shown on the Plans or Standard Drawings.

Mitered joints shall be welded from the inside where practicable. Welded joints shall be as smooth and even as practicable. Welded joints shall be repaired according to Section 66-3.05, "Damaged Galvanizing", of the State Specifications.

All fabrication shall be done in accordance with generally accepted practice for good workmanship. The Contractor shall notify the Agency at least forty-eight (48) hours before delivery of the fittings so the Agency may inspect the fittings at the fabrication plant.

Diameter of fittings depends on the pipe option selected by the Contractor. Upstream diameter of fittings shall match upstream pipe diameter; downstream diameter of fittings shall match downstream pipe diameter.

If the size of the corrugated pipe fitting is too large to conveniently fabricate or transport in one (1) piece, the fitting may be fabricated in two (2) or more parts which will then be jointed at the site with couplings. The joint shall be located sufficiently distant from a welded joint so that there is no interference between the coupling and the welded joint.

50-28 RIBBED STEEL PIPE (RSP)

Ribbed steel pipe shall meet the requirements for corrugated steel pipe in Section 66, "Corrugated Metal Pipe", of the State Specifications, except as modified in these Specifications. Ribbed steel pipe shall only be used when specified in the Special Provisions. Steel shall be zinc coated unless otherwise specified. Ribbed steel pipe shall be fabricated to one of the following configurations:

- a. The pipe shall be fabricated to meet the requirements for Type IR pipe as specified in ASTM Designation: A 760, Sections 4, 7, 8, and 10; or
- b. The pipe shall consist of pipe with 3/4" x 3/4" inside dimension, outward projecting reinforcing ribs located on approximately 7-1/2" centers. These ribs shall be located symmetrically between lockseams, which shall be on approximately 22-1/2" centers. All ribs shall be helical and continuous.

Ribbed steel pipe shall be fabricated with a continuous helical lock seam in accordance with Section 66, "Corrugated Metal Pipe", of the State Specifications. Lock seams shall develop the full strength of the pipe.

The pipe shall be furnished with re-rolled ends to produce a profile for connecting with the approved coupling band.

Any pipe that has been damaged during fabrication, handling, or construction shall be rejected or repaired to the satisfaction of the Agency.

Lateral field connections between metal pipes shall be welded and any galvanizing damaged by welding shall be repaired according to Section 66, "Corrugated Metal Pipe", of the State Specifications.

When shown on the Plans or specified in the Special Provisions, the pipe, couplings, and fittings shall be protected with a bituminous coating as specified in Section 66-1.03, "Protective Coating, Linings and Pavings", of the State Specifications. Ribbed steel pipe shall be shipped, handled, and laid in such a manner as to prevent bruising, scaling or breaking of the galvanized surface or protective coating.

Coupling bands for ribbed steel pipe shall be manufactured from 0.064 inch thick galvanized steel conforming to Section 66, "Corrugated Metal Pipe", of the State Specifications. The coupling bands shall be either a hat shaped band, winged band, annular band, or other approved design and shall be fitted with gaskets fabricated from neoprene or butyl rubber or other durable, resilient material approved by the Agency, and assembled in such a manner as to form a sealed joint.

Hat shaped band and winged band couplers shall conform to the following table:

TABLE 50-4 BAND COUPLER/RIBBED STEEL PIPE (Dimensions in Inches)					
Pipe Size	Band Type	Band Minimum Thickness	Flange Height	Band Width	Bolt Diameter
24 - 36	Hat	0.064	5/8	2-3/4	1/2
42 - 90	Winged	0.064	5/8	7-1/2	1/2* *(2 required)

Ribbed steel pipe fittings shall conform to the requirements for corrugated steel pipe fittings specified in Section 50-27, "Corrugated Steel Pipe (CSP)", in this Section of these Specifications, except material shall be ribbed steel.

50-29 CORRUGATED ALUMINUM PIPE (CAP)

Corrugated aluminum pipe shall conform to the material and fabrication methods of AASHTO Designation M196 and as modified herein. Corrugated aluminum pipe shall only be used when specified in the Special Provisions. All corrugated aluminum pipe shall be fabricated with helical corrugations and with a continuous lock seam extending from end to end of each length of pipe.

Helically corrugated aluminum pipe shall be fabricated using corrugation profiles as shown in the following table:

TABLE 50-5 CORRUGATION PROFILE			
Diameter (Inches)	Normal Pitch (Inches)	Maximum Pitch (Inches)	Minimum Depth (Inches)
8 and 10	1-1/2	1-7/8	1/4
12 through 96	2-2/3	2-3/4	1/2
48 through 120	3	3-1/4	1
Note: The corrugation profile of 2-2/3" x 1/2" shall be used for all pipes from twelve-inch (12") through ninety-six-inch (96") diameter, unless otherwise shown on or specified in the Contract.			

Couplings for corrugated aluminum pipe shall be of a durable, tight design. Couplings shall consist of aluminum coupling bands fitted with gaskets fabricated from neoprene or butyl rubber, or other durable resilient material approved by the Agency and assembled to form a tight joint. The Agency may require that the coupling design be submitted for approval prior to placing, and may require the supporting data showing that the coupling is tight and durable. Heat-shrinkable plastic couplings will not be permitted.

Corrugated aluminum pipe fittings shall be constructed of the gauge aluminum indicated on the Plans.

The fittings shall conform to the details shown on the Plans or Standard Drawings.

All fabrication shall be done in accordance with generally accepted practice for good workmanship. The Contractor shall notify the Agency at least forty-eight (48) hours before delivery of the fittings so that the Agency may inspect the fittings at the fabrication plant.

Diameter of the fittings will depend on the pipe option selected by the Contractor. Upstream diameter of the fittings shall match upstream pipe diameter; downstream diameter of fittings shall match downstream pipe diameter.

If the size of the corrugated pipe fitting is too large to conveniently fabricate or transport in one piece, the fitting may be fabricated in two (2) or more parts, which will then be jointed at the site with couplings. The joint shall be located sufficiently distant from a welded joint so that there is no interference between the coupling and the welded joint.

50-30 HIGH DENSITY POLYETHYLENE PIPE (HDPE)

High Density Polyethylene Pipe (HDPE) shall conform to AASHTO M294 or MP7-97 Type S or Type D with inside diameters of twelve inches (12”) to sixty inches (60”). Pipe joints shall be bell and spigot or welded type, certified capable of watertight performance, with O-ring gaskets meeting ASTM Designation: F 477. The assembly of joints shall be in accordance with the pipe manufacturer's recommendations and the requirements of ASTM Designation: D 3212. The quality of the material and installation shall meet or exceed the requirements of Section 38-10, "Testing of Pipe", of these Specifications. Pipe dimensions are nominal inside diameters. The average inside diameter shall not vary more than the following:

<u>Pipe Diameter</u>	<u>Maximum</u>
12" through 18"	1/4 inch
21" through 24"	3/8 inch
Over 24"	1/2 inch

The HDPE compounds shall conform to the following cell classifications as provided in ASTM Designation: D 3350:

<u>Property</u>	<u>Cell Classification</u>
Density	3
Melt Index	2 ^(a) , 3 or 4
Flexural Modulus	4, 5 or 6
Tensile Strength	4, 5 or 6
Environmental Stress Crack Resistance	1, 2 or 3
Hydrostatic Design Basis	0, 1, 2, 3 or 4
Ultraviolet-Stabilizer	C ^(b)

^(a) The Melt Index for Cell Classification 2 material used to manufacture pipe shall not be greater than 0.6. Rotationally molded couplings and end fittings may be produced from material compounds having a Melt Index Cell Classification of 1.

^(b) HDPE resin shall contain not less than two percent plus or minus one-half percent (2% ± 1/2%) carbon black ultraviolet stabilizer.

Wall thickness of Type S corrugated polyethylene pipe shall be the thickness of the inner liner measured between corrugation valleys. The wall thickness of the polyethylene pipe, measured as specified above, shall equal or exceed the minimum wall thickness values in Table 50-6.

The pipe stiffness shall be determined in accordance with ASTM Designation: D 2412 at five percent (5%) deflection. Average pipe stiffness shall be determined for each manufactured run from three (3) test specimens. The length of test specimens shall be one pipe diameter or a maximum of thirty-six inches (36”), whichever is less. The average pipe stiffness shall equal or exceed the minimum pipe stiffness value for each size of HDPE pipe listed in Table 50-6 below.

The pipe unit weight for corrugated HDPE shall be computed as the average weight per foot of length determined from three (3) test specimens, taken from each manufactured run. Each test specimen for pipes twenty-four inches (24”) in diameter and less shall be a minimum length of two (2) pipe diameters. Test specimens for pipes larger than twenty-four inches (24”) in diameter shall be one (1) diameter or a maximum of thirty-six inches (36”), whichever is less. The weight of pipe specimens shall be determined with any suitable weighing device accurate to 0.10 pounds. The pipe unit weight for each size of polyethylene pipe shall equal or exceed the minimum unit weight value for each size of plastic pipe listed in Table 50-6.

TABLE 50-6			
HDPE PIPE			
Nominal Diameter (inches)	Minimum Wall Thickness (inches)	Minimum Pipe Stiffness (PSI)	Minimum Unit Weight (lbs. per linear foot)
12	0.035	45	2.7
15	0.035	42	4.0
18	0.050	40	6.0
24	0.050	34	10.2
30	0.050	28	15.0
36	0.050	22	18.1

50-31 FIELD ASSEMBLED PLATE CULVERT

Field assembled plate culverts shall conform to Section 67, “Structural Metal Plate Pipe”, of the State Specifications.

50-32 REINFORCING STEEL

Reinforcing steel shall conform to Section 52, “Reinforcement”, of the State Specifications. Unless shown or specified in the Contract, bar reinforcement shall be deformed Grade 60 conforming to ASTM Designation: A 615.

Welded steel wire fabric for concrete reinforcement shall conform to ASTM Designation: A 185. The gauge of the wire and the dimensions of the mesh will be as shown or specified in the Contract.

50-33 CURB DOWEL AND TIE BARS

Dowel and tie bars for curbs shall be bar reinforcement conforming to Section 50-32, “Reinforcing Steel”, in this Section of these Specifications. At the Contractor's option, either Grade 60 or Grade 40 may be used.

50-34 SEWER AND STORM DRAIN CASTINGS

Castings for manhole frames and covers, drop inlet frames, gutter drain frames, open-back hoods, flushing branch frames and covers, or other purposes shall be tough gray iron, free from cracks, holes, swells, and cold sheets, and be of workmanlike finish. A "Certificate of Compliance" signed by an authorized agent of the manufacturer or supplier shall be required and shall be delivered to the Agency. Each certificate so furnished shall be accompanied by a copy of test results stating that the material has been sampled, tested, and inspected in accordance with the provisions of ASTM Designation: A 48, Gray Iron Castings Class 35B.

Test bars shall be cast and tested for the first lot of casting and every four (4) months thereafter. If production is interrupted for any period longer than four (4) months, test bars shall be cast and tested from the initial lot after production is resumed and every four (4) months thereafter. The first lot is defined as the first castings produced after January 1 every year. The tension tests specified shall be performed and the results certified by an independent testing laboratory.

The cast iron shall meet the requirements of ASTM Designation: A 48, Class 35. The seating faces of manhole covers and frames shall be machined as shown on the Standard Drawings or Plans to assure a tight fit and prevent rocking. The name of the manufacturer shall be cast on the manhole cover and frame. In addition, the day, month, and year of manufacture shall be cast on the frame and cover adjacent to the name of the manufacturer.

Twenty-four inch (24") diameter manhole frames and covers shall conform to Standard Drawings 9-9 and 9-11 for storm drain and Standard Drawings 7-11 through 7-11B for sanitary sewer, unless otherwise shown on the Plans or specified in the Special Provisions.

Thirty-six inch (36") diameter manhole frames and covers shall conform to Standard Drawings 9-10 for storm drain and Standard Drawings 7-12, 7-12A, or 7-12B for sanitary sewers, unless otherwise shown on the Plans or in the Special Provisions.

The CSD-1 logo covers are required on all County Sanitation District 1 sewer lines; the SRCSD logo covers are required on all Sacramento Regional County Sanitation District sewer lines.

When required by the Agency, proof-load tests shall be performed on manhole frames and covers in accordance with Section 3.3 of Federal Specification A-A-60005.

When locking type covers are specified for storm drain manholes, they shall be standard covers drilled and tapped on 120° centers and bolted to the frame with 7/16" x 1-1/4" brass hex head cap screws. When locking type covers are specified for sanitary sewer manholes, they shall conform to Standard Drawings 7-11A, 7-12, 7-12A or 7-12B, unless otherwise shown on the Plans or specified in the Special Provisions.

Exposed edges of castings shall be chamfered or rounded, and all exposed surfaces shall be smooth unless otherwise shown.

Manhole frames and covers shall be clearly marked with the country of origin as specified in the Trade of Tariff Act of 1984.

At the Contractor's option, drop inlet frames and open back hoods may be fabricated from steel plate as structural shapes in lieu of cast iron. If the Contractor elects to use fabricated steel drop inlet frames or open back hoods, the Contractor shall submit Working Drawings to the Agency for approval prior to fabrication. This submittal requirement does not apply to the drop inlet frame shown on Standard Drawing 9-14.

50-35 WATER PIPE

Water distribution system pipe shall be of the material type as shown or specified in the Contract and shall conform to the following requirements.

All pipes shall be the regular product of a firm which has successfully manufactured comparable pipe for at least three (3) years.

All pipe, valves, fittings, connections, and appurtenances shall conform to the provisions of these Specifications or as set forth in the Special Provisions. The Agency maintains a list of approved hydrants and water service material and fittings, and material used in the Work shall be limited to those listed. Alternative material items may be added to this list upon review and testing by the Agency.

All testing requirements of the ASTM and AWWA specifications shall be conducted by the pipe manufacturer or the manufacturer's representative within the State of California. The resulting tests shall be certified by an established reputable firm operating in the testing materials field. The certification shall accompany the delivery of the materials to the work site.

Joints shall be push-on or mechanical type and shall conform to ANSI 21.11 (AWWA C111) or ASTM D 3139 with elastomeric gaskets unless otherwise specified in the Contract. Gasket lubricant shall be minimum required plus ten percent (10%).

Ductile iron pipe shall conform to the requirements of Section 50-25, "Ductile Iron Pipe (DIP), and Cast Iron Pipe and Ductile Iron Fittings", in this Section of these Specifications, unless specified otherwise in the Contract. Ductile iron pipe shall be encased in 8-mil polyethylene in accordance with AWWA C105.

Polyvinyl Chloride (PVC) Pipe for water distribution systems shall conform to Section 50-26.02, "Small PVC Pressure Sanitary Sewers", in this Section of these Specifications, unless specified otherwise in the Contract.

50-36 WATER PIPE FITTINGS

Fittings shall have push-on, mechanical joint or flanged ends. Four-inch (4") through twelve-inch (12") fittings shall be ductile iron; fittings larger than twelve inches (12") shall be cast iron or ductile iron. All fittings shall conform to ANSI 21.4 (AWWA C104), ANSI 21.10 (AWWA C110), ANSI 21.11 (AWWA C111), or AWWA C153 designed for a working pressure of 250 or 350 psi. Coating and lining requirements shall be the same as specified for the pipe. Fittings shall be encased in 8-mil polyethylene in accordance with ANSI A21.5 (AWWA C105).

50-37 FIRE HYDRANTS

Fire hydrants shall conform to the requirements of Standard Drawings 8-2A and 8-2B. Fire hydrants shall be wet barrel type meeting the requirements of AWWA Standards C503. Wet barrel hydrants shall have a replaceable flanged spool "breakable" section to be installed two inches (2") above the ground. Use all solid bolts on "breakable" spool sections.

Delivery classification shall be two-hose and one-pumper nozzle, having "National Standard Fire Hose Coupling Screw Threads" conforming to NFPA 194 and ANSI B 26. Hose nozzles shall be for two and one-half inch (2-1/2") hose and pumper nozzle shall be for four and one-half inch (4-1/2") hose. The operating nuts and nozzle caps shall be National Standard pentagon dimensions, open left (counter clockwise).

Hydrants shall be furnished with two layers of factory-applied white coatings. Coatings shall be polyurethane epoxy, Alkyd, or epoxy base coat with Acrylic topcoat. Coating thickness shall be in accordance with coating manufacturer's requirements. Epoxy topcoats shall not be allowed.

Field touch-ups of damage to coating shall be done with coating sample provided by the manufacturer, and shall be the same type and color as the factory applied coating.

50-38 VALVES

Types of valves to be installed will be specified in the Contract. Unless otherwise shown on the Plans, valves provided shall open to the left (counter-clockwise), and be furnished with flange, mechanical or push-on joint. Valves shall bear the registered certification mark of the

AWWA. All installed valves shall operate smoothly with no more than twenty-five (25) ft-lbs. torque. Valves operating at torques greater than twenty-five (25) ft-lbs. require approval by the Agency. Valves three inches (3") through eight inches (8") shall be gate valves. Ten-inch (10") valves may be gate or butterfly valves. Valves twelve inches (12") and larger shall be butterfly valves.

50-38.01 Gate Valves

Gate Valves shall be ductile iron body, with bronze stem nuts, glands and bushings, non-rising stem (NRS), working water pressure of two hundred (200) psi, conforming to the requirements of AWWA Standard C509. Resilient-seated gate valves shall have resilient seats bonded or mechanically attached to the gate. The valve shall have a two-inch (2") square operating nut. Unless otherwise specified or shown on the Plans, valves shall be furnished with ends flanged or mechanical joint, using an elastomeric-gasket seal, and shall conform in dimensions and style to the pipe and/or fitting requirements. All gate valves shall be coated and lined with a two-part polyamide epoxy in accordance with AWWA Standard C550-90. Metal surfaces to be coated or lined shall be sandblasted in accordance with SSPC-SP10. Finished or bearing surfaces shall not be painted. Exposed machined surfaces shall be covered with slush grease or other readily removable protective coating before shipment.

50-38.02 Butterfly Valves

Butterfly valves shall meet AWWA Standard C504 Standard for Rubber-Seated Butterfly Valves, Class 150B, Short Body and the requirements of this Section. Butterfly valves shall be rated at one hundred fifty (150) psi working pressure and provide drip tight shut-off at one hundred fifty (150) psi of pressure. Butterfly valves shall have flanged ends that meet the requirements of AWWA C207 Class D flanges. All valves shall be provided with manual actuators, and shall open counter-clockwise.

Butterfly valves shall be constructed of the following materials:

Shaft—Type 304 Stainless Steel, ASTM A276

Disc—Cast Iron, ASTM A-126 Class B or ASTM A-48 Class 40

Disc Edge—Type 316 Stainless Steel

Rubber Seat—Neoprene or Buna-N

Body—Cast Iron, ASTM A126, Class B

Lining—Polyamide epoxy, minimum dry thickness six (6) mils, NSF approved for potable water

Valve body shall be a one-piece casting and shall include two integral B16.1 Class 125 flat-face flanges, two bearing trunnions and a pad for mounting bonnet with actuator. Raised marking plate shall be welded or riveted to the valve body showing the manufacturer's name or mark, the year of valve casting, the valve diameter and the AWWA class rating.

Valves seats shall be mechanically retained in or suitably cemented to the valve body so as to adhere without leakage under all conditions of service. Valve seats shall be Buna N rubber or Neoprene located on the valve body. For valve sizes twenty inches (20") and smaller, valves shall have bonded seats that must withstand a seventy (70) pound pull under ASTM Designation: D 429 test procedure. Bonded seats shall be located in recessed groove in the valve body. Seating edge shall be 316 stainless steel metal, ground smooth and polished. Seating edge shall be located on the valve disc.

Since the entire valve and actuator will be coated for corrosion resistance, a cast-iron spacer will be provided between the actuator and valve body, which will completely seal off their interconnecting shaft and the main valve shaft stuffing box, if present.

The valve shaft seals shall be self-adjusting, Chevron V-Type packing seals. Shaft seals shall be designed to allow replacement of the seals without having to remove the valve shaft.

Valve actuator shall be of the buried and submersible, permanently lubricated traveling nut type for valves twelve inches (12") and smaller terminating in a water works standard two inch (2") square operating nut marked for direction of opening. The manual actuator shall be designed to produce the required maximum torque at the operating nut of one hundred fifty (150) foot-pounds.

The valve actuator shall be fully greased-packed and have stops in the open/close position. The actuator shall have a mechanical stop that will withstand an input force of four hundred fifty (450) ft-lbs. The mechanism shall be inherently self-locking and shall hold the valve disc rigidly in position, free of flutter, for any degree of valve opening.

Machining and fitting of each part shall be held to a close tolerance to minimize backlash and lost motion. The mechanism shall be totally enclosed in a rugged lubricant tight and watertight case. The actuator shall have a bleed-off connection to protect against leakage past the shaft packing from entering the actuator housing. A gasketed removable cover plate shall be provided for maintenance purposes. All moving parts shall work completely submerged in a petroleum based grease. The case shall be filled with the proper lubricant and sealed before shipment.

The operating screw rod shall be high strength steel. All external bolts, and nuts on the actuator housing shall be cadmium plated high strength steel.

All butterfly valves shall be coated and lined with a two-part polyamide epoxy in accordance with AWWA Standard C550-90. Metal surfaces to be coated or lined shall be sandblasted in accordance with SSPC-SP10. Finished or bearing surfaces shall not be painted. Exposed machined surfaces shall be covered with slush grease or other readily removable protective coating before shipment.

50-38.03 Air Release/Vacuum Valves

Air valves shall be air release/vacuum type valves. The body and cover of the valve shall be cast iron unless otherwise approved by the Agency. All interior parts shall be stainless steel. Air release/vacuum valves shall be fully automatic and requiring no regular maintenance.

Air release/vacuum valves shall be capable of automatically releasing accumulated air from a water system while that system is in operation and under pressure. Also, the valve shall automatically allow air to reenter the pipeline when the internal pressure of the pipeline becomes negative due to draining of the pipeline, a power outage, pipeline break, etc.

Air release/vacuum valves shall be set plumb, and properly fitted to the high points on the water main. Air release/vacuum valves will be required at other locations on long stretches of pipe as shown on the plans. A vault with adequate venting and drainage shall be provided as required. The air release/vacuum valve and all appurtenances shall be of material listed and shall be installed as shown in Standard Details 8-14A or 8-14B.

50-39 VALVE BOXES, COVERS, DROP CAPS, AND SERVICE VALVE BOXES

Valve boxes for traffic service shall be of precast concrete, and shall have a cast iron face and a cast iron traffic lid. Valve boxes out of traffic areas shall be of precast concrete, with a cast iron lid. Covers shall be marked "WATER" and shall have a loose fit in the box. Valve box risers shall be of PVC C900 (blue or white for potable water mains). Materials shall be provided and installed in accordance with Standard Drawing 8-5.

50-40 WATER SERVICE CONNECTION MATERIALS

50-40.01 General

Water services and meters shall conform to Standard Drawings 8-1 and 8-6A, 8-6B or 8-6C, depending on size and type of service. Residential water service lines shall be one inch (1") in diameter unless otherwise specified.

Water service pipe material up to and including two inches (2") in diameter shall be polyethylene pressure pipe meeting standards of AWWA C901, or copper water tubing, "Type K", soft tempered, meeting ASTM Designation: B 88 and AWWA C800. Polyethylene pipe shall be high density, ultra-high molecular weight and meet all applicable requirements, including testing, of Type III, Grade P33 or P34, Class C, designated as PE 3408 in ASTM D2239 and D1248. The polyethylene pipe shall have a minimum pressure rating of 200 psi, shall be homogeneous throughout and free of cracks, holes, foreign inclusions or other defects, shall be uniform in color, opacity, density and other physical properties. Polyethylene pipe shall be supplied with markings, at intervals of not more than five feet (5'), indicating nominal pipe size, designation, pressure class, and manufacturer's name or trademark. Polyethylene shall be manufactured to iron pipe size (IPS).

Material for service lines three inches (3") in diameter or larger shall be "Type K" copper or ductile iron. Material for service lines four inches (4") in diameter and larger shall be ductile iron or polyvinyl chloride (C900) meeting the applicable requirements of this Section 50. When the size of the tap exceeds the manufacturer's recommended limit for the size of the main, a special fitting shall be furnished. All underground copper services shall be protected from corrosion by wrapping or sleeving in eight (8) mil polyethylene.

The Agency maintains a listing of approved water service connection fittings that establish a standard of material quality. Fittings used shall be limited to those on the list. Alternative material may be added to this list upon review, test and acceptance by the Agency.

50-40.02 Water Meters and Meter Boxes

Water meters and appurtenances shall be installed in accordance with and of the material type and brand described in Standard Drawings 8-6A, 8-6B, or 8-6C, depending on the size of the water meter. The size and type of meter (positive displacement, turbine, or compound) shall be as described on the Plans.

50-41 JOINT MATERIALS FOR MANHOLES

Joint materials for precast reinforced concrete manhole sections shall conform to one of the following:

1. Mortar proportioned as one (1) cubic foot of portland cement to two (2) cubic feet of concrete sand. All mortar shall be used within thirty (30) minutes after the mixing water has been added.
2. Preformed plastic sealing compound shall conform to Type 1 - Rope Form, one and one-half inch (1-1/2") diameter, Federal Specification SS-S-210A.
3. Gulf States Pre-Extruded concrete joint sealant.

50-42 FENCING - CHAIN LINK

Chain link fence and gate materials shall conform to Section 80, "Fences", of the State Specifications, and these Specifications.

The carbon content of steel posts shall not exceed 0.82 percent.

Chain link fence fabric shall meet the requirements of zinc-coated steel chain link fence fabric, ASTM Designation: A 392 with Class 1 zinc coating. Unless otherwise shown on the Plans or specified in the Special Provisions, the fabric shall be a two-inch (2") mesh of nine (9)

gauge wire, with a minimum breaking strength of one thousand two hundred ninety (1,290) pounds.

Vinyl coated chain link fence fabric, when shown on the Plans or specified in the Special Provisions, shall be black polyvinyl chloride coated steel link fabric and fittings. Polyvinyl chloride shall be applied by the thermal extrusion process.

Slats shall be as specified in the Special Provisions.

Base material for the manufacture of steel pipe used for posts, braces, rails and gate frames shall be commercial quality, or better, weldable steel, conforming to the specifications of ASTM Designation: A 120. At the option of the Contractor, and upon approval of the Agency; high-strength tubing fabricated by cold rolling and radio frequency welding from steel conforming to ASTM Designation: A 446, Grade D, may be used provided that the product of the yield strength and the section modulus shall not be less than that of pipe conforming to ASTM Designation: A 120.

The base material for the manufacture of other steel sections used for posts and braces shall conform to ASTM Designation: A 572, Grade 45, with a minimum yield strength of forty thousand (40,000) pounds per square inch. All posts, braces, rails and gate frames shall be hot dipped galvanized in accordance with ASTM Designation: A 123, or ASTM Designation: A 525, Coating Designation G235 plus chromate conversion coating and 0.4 mils minimum thickness finish coat of clear, cross-linked acrylic.

Posts and rails for vinyl coated chain link fence shall be hot dipped galvanized and covered with two (2) coats of black metal paint applied over a metal primer.

Posts and rails shall be as specified in the following Table 50-7, unless otherwise shown or specified in the Contract. The Contractor shall have the option of section types to be used with the condition that the option exercised shall be uniform throughout the Work.

TABLE 50-7 CHAIN LINK FENCING – POSTS AND RAILS				
Fence Member		Section Type	Dimension O.D.	Minimum Weight (Pounds Per Linear Foot)
Line Posts		C-Section	1.875"	2.15
		Sch. 40 pipe	2.375"	3.65
		Hi-Strength tubing	2.375"	3.12
Terminal, Corner & Latch Posts		Sch. 40 pipe'	2.875"	5.79
		Hi-Strength tubing	2.875"	4.64
Horizontal & Diagonal Braces, Top Rails		C-Section	1.825"	1.35
		Sch. 40 pipe	1.660"	2.27
		Hi-Strength tubing	1.660"	1.82
Gate Frames		Sch. 40 pipe	2.375"	3.65
		Hi-Strength tubing	2.375"	3.12
Gate Posts	Gate width up through 6'	Sch. 40 pipe	2.875"	5.79
	Gate width over 6' through 12'	Sch. 40 pipe	4.500"	10.79
	Gate width over 12' through 18'	Sch. 40 pipe	5.563"	14.62
	Gate width over 18' to 24' max	Sch. 40 pipe	6.625"	18.97

Fittings shall be hot-dip galvanized and shall be of malleable, cast iron, or pressed steel.

A Certificate of Compliance in accordance with the provisions of Section 6-1.07, "Certificates of Compliance", of the State Specifications, shall be furnished to the Agency prior to the installation of any chain link fencing, gates or components.

50-43 LANDSCAPING MATERIALS

50-43.01 Topsoil

Topsoil shall be sandy loam of an even texture and shall pass through a one-half inch (1/2") screen.

The topsoil shall be free from insects, animal life, or any toxic substances that may be detrimental to the growth of vegetation. Topsoil shall be capable of sustaining healthy plant life.

Soil sterilizers or weed killers shall permit growth of nursery stock planted three (3) weeks after application. Compounds containing cyanide or arsenic will not be allowed.

The Contractor shall provide a soils report to the Agency for approval prior to placement of topsoil. The report shall indicate conformance with these Specifications and the following:

SOIL ELEMENTS	ACCEPTABLE RANGE
pH	6.6 - 8.0
CEC (Cation Exchange Capacity)	12.00 - 35.00 meg/100g
SAR (Sodium Absorption Ratio)	less than 5.00
ESP (Exchangeable Sodium Percentage)	less than 5.00
EC (Electronic Conductivity)	2.0 - 2.5 mmho/cm
SP (Sodium Percentage)	less than 45%
Percentage Organic Matter	2% - 5%

Topsoil shall be delivered reasonably dry and in a workable condition.

Sandy loam of low fertility, even though mixed with leaf mold, manure, or other fertilizers, will not be acceptable unless prior approval has been granted by the Agency. The Contractor shall attach soil and plant Lab Report for the Agency's approval.

50-43.02 Commercial Fertilizer

Planting tablets for planting trees and shrubs shall be tightly compressed, non-burning, long lasting fertilizer, weighing between 5 and 12.5 grams of the following guaranteed analysis:

Nitrogen, water soluble	7.00%
Nitrogen, water insoluble	13.00%
Phosphoric Acid, available	10.00%
Potash, soluble	5.00%
Calcium combined	2.60%
Sulfur, combined	1.60%
Iron, expressed as Fe	0.35%

Quantity of planting tablets per plant shall be based on the manufacturer's recommendation unless otherwise specified in the Special Provisions.

Fertilizer used for planting maintenance shall have a minimum guaranteed chemical analysis of twenty-one percent (21%) nitrogen, zero percent (0%) phosphoric acid, and zero percent (0%) soluble potash.

Fertilizer for turf installation, unless otherwise specified, shall have a minimum guaranteed chemical analysis of twenty-one percent (21%) nitrogen, ten percent (10%) phosphoric acid and ten percent (10%) soluble potash.

Fertilizer for tree, turf, and shrub plantings shall be in granular or pelleted form, shall conform to the standards of the Association of Official Agricultural Chemists, and shall provide the minimum percentage of available nutrients as specified in the Plans or Special Provisions. A liquid fertilizer may be used when specified in the Special Provisions.

Fertilizer used for erosion control work shall be in a form which will readily disperse into the slurry, and shall have a minimum guaranteed chemical analysis of six percent (6%) nitrogen, twenty percent (20%) phosphoric acid, and twenty percent (20%) soluble potash.

50-43.03 Soil Amendment

Soil amendment shall be a ground wood product such as bark or redwood fortified with nitrogen and treated to absorb water quickly, or a relatively dry organic compost derived from sewage sludge. Soil amendment shall be friable and shall be free of weed seed, dust and other objectionable materials. Soil amendment shall pass a one-inch (1") sieve and shall comply with the requirements in the California Food and Agricultural Code.

50-43.04 Iron Sulfate

Iron sulfate shall be ferrous sulfate in pelleted or granular form containing not less than 18.5 percent iron expressed as metallic iron. Iron sulfate shall conform to the requirements of the California Food and Agricultural Code.

50-43.05 Straw

Straw shall be derived from wheat, rice or barley. The Contractor shall furnish to the Agency evidence that clearance has been obtained from the Sacramento County Agricultural Commissioner, as required by law, before straw obtained from outside the County is delivered to the site of the Work. Straw that has been used for stable bedding shall not be used.

50-43.06 Fiber

Fiber used for hydroseeding shall be produced from natural or recycled (pulp) fiber, such as wood chips or similar wood materials or from newsprint, chipboard, corrugated cardboard or a combination of these processed materials, and shall be free of synthetic or plastic materials. Fiber shall disperse uniformly into a slurry when mixed with water. Fiber shall be colored to contrast with the area on which the fiber is to be applied, and shall not stain concrete or painted surfaces. The slurry, when hydraulically applied to the ground, shall form an absorptive mat of mulch uniformly impregnated with seed and other ingredients. No materials that inhibit growth or germination shall be present in the mixture.

50-43.07 Mulch

Unless otherwise specified in the Special Provisions or shown on the Plans, mulch shall consist of wood chips, tree bark, or shredded bark, or any combination thereof, at the Contractor's option. Shredded redwood bark ("gorilla hair") shall not be used. Materials deemed highly flammable or a potential fire hazard by the Agency shall not be used.

Wood chips shall be manufactured from clean wood. The particle size of the chips shall be between one-half inch (1/2") and three inches (3") in length, and not less than three-eighths inch (3/8") in width and one-sixteenth inch (1/16") in thickness. At least 85 percent, by volume, of wood chips shall conform to the sizes specified.

Tree bark shall have a particle size between one-half inch (1/2") and one-and-one-half inches (1-1/2") and shall be free of salt and foreign materials such as clods, coarse objects, sticks, rocks, weeds or weed seeds.

Shredded bark shall be a mixture of shredded bark and wood; shall have a particle size between one-eighth inch (1/8") and one-and-one-half inches (1-1/2") in thickness and one inch (1") to eight inches (8") in length; and shall be free of salt and deleterious materials such as clods, coarse objects, and rocks. At least seventy-five percent (75%), by volume, of shredded bark shall conform to the sizes specified.

50-43.08 Planting Mix

Planting mix for backfilling planting holes shall consist of two (2) parts of soil excavated from the planting holes free of rocks over one-half inch (1/2") in diameter and one part soil amendment. The materials shall be thoroughly mixed.

50-43.09 Seed

Seed shall be furnished separately or in mixtures in standard sealed containers labeled with the seed name, lot number, net weight, percentage of purity, germination and hard seed, and percentage of maximum wildflower or grass seed content for each kind of seed furnished and, in the case of a mixture, the proportions of each kind of seed.

The Contractor shall furnish the Agency duplicate signed copies of a certificate of compliance by the vendor certifying that each lot of seed has been tested by a recognized laboratory for seed testing within six (6) months of date of delivery. The testing shall be in conformance with test procedure standards of the Association of Official Seed Analysts and the

provisions of the Agricultural Code of the State of California. The certificate of compliance shall include name and address of laboratory, date of test, lot number for each kind of seed, and results of tests as to name, percentages of purity and of germination, and percentage of wildflower or grass content for each kind of seed furnished and, in case of a mixture, the proportions of each kind of seed.

Seed with less than the specified purity or germination may be used under the following conditions:

- a. The application rate for such seed shall be increased to compensate for the less than specified purity or germination.
- b. Prior to using such seed, the Contractor shall submit to the Agency the purity and germination percentages, and the proposed increased application rate for such seed.
- c. No such seed shall be used before the Agency has approved, in writing, the use of such seed and the increased application rate.
- d. The additional seed required because of the increased application rate shall be furnished and applied at the Contractor's expense.

Seed specified without a purity or germination requirement shall be labeled to include the name, date (month and year) collected and name and address of the supplier. Said seed shall be, at the time of sowing, from the previous or current year's harvest.

Seeds that become wet, moldy, or otherwise damaged in transit or in storage will be subject to retest at the discretion of the Landscape Architect.

50-43.09.A Turf Seed

Turf seed or mixtures of seed are classified by type according to species or variety of grass. Types of seed or seed mixtures shall be as shown on the Plans or specified in the Special Provisions.

Lawn seed shall be true to species or variety for the type as specified and shall conform to the Agricultural Code of the State of California and the standards of the Association of Official Seed Analysts.

50-43.09.B Wildflower Seed for Hydroseeding

Wildflower seed type to be used for hydroseeding shall be as indicated in the Plans or Special Provisions.

Seed shall be labeled in accordance with the California Department of Agriculture, State Seed Law requirements, effective on the date of invitation for bids. The seed shall be supplied in unopened containers from a commercial seed dealer and may either be mixed or in separate containers for each lot. Tags shall be given to the Agency. Final acceptance will not be considered unless all tags are produced and verified.

50-43.10 Stabilizing Emulsion

Stabilizing emulsion (tackier or binder) shall be a concentrated liquid chemical that forms a plastic film upon drying and allows water and air to penetrate. The film shall be nonflammable and shall have an effective life of at least one year.

Stabilizing emulsion shall be nontoxic to plant or animal life and non-staining to concrete or painted surfaces. In the cured state, the stabilizing emulsion shall not be re-emulsifiable. Stabilizing emulsion shall be miscible with water at the time of mixing and application.

50-43.11 Lumber

Lumber shall be construction grade cedar, pressure treated Douglas fir, or heart redwood, rough cut, from sound timber. It shall be straight and free from loose or unsound knots, shakes in excess of 1/3 the thickness of the lumber, splits longer than the thickness of the lumber, or other defect which would render the lumber unfit structurally for the purpose intended. Knots in

all lumber shall be sound, tight, well spaced, and shall not exceed two inches (2") in size on any face. Sweep shall not exceed 0.08 foot in six feet (6').

50-43.12 Tree Stakes and Ties

Stakes for support of trees shall be lodge-pole pine, unless otherwise specified in the Special Provisions. Stakes for fifteen- (15) gallon trees or smaller shall be two-inch (2") diameter x ten feet (10') long. Stakes for twenty-four inch (24") box trees or larger shall be two-inch (2") diameter x twelve feet (12') long. The tree ties shall be black rubber cinch ties, unless otherwise specified in the Special Provisions.

50-43.13 Root Control Barrier

Root control barrier shall be an injection molded or extruded modular component made of high density polypropylene or polyethylene plastic. Panels shall have a minimum thickness of 0.080 inch (2.032 mm). Each panel shall have molded vertical ribs (four minimum) and locking strips or integral male/female sliding locks. Vertical root deflecting ribs or channels shall be one-half inch (1/2") high, perpendicular to the panel, and between six (6) and eight (8) inches apart. Panel shall be twenty-four inch x twenty-four inch (24" x 24") size unless otherwise specified in the Special Provisions.

50-43.14 Plants

Plants shall be of the variety and size shown on the Plans or specified in the Special Provisions and shall conform to the requirements of these Specifications.

Plants shall be vigorous, first class representations of the species and cultivars specified, and shall conform to State and local laws governing the sale and transportation of plant materials. Only plants of the size and type shown on the Plans or designated in these Specifications or the Special Provisions, and only plants with normal plant and root structures will be acceptable.

All plants shall be nursery grown in containers, unless otherwise shown on the Plans or designated in the Special Provisions, and shall have been grown in the specified containers for not less than six (6) months. They shall have straight, single trunks, unless otherwise specified on the Plans. No pruning shall be undertaken before planting. Plants specified as multi-trunk shall have at least three (3) main leaders from the base.

Any and all plants that have any encircling roots (not rootbound) shall have root balls lightly slashed on a minimum of three (3) sides to stop encircling root growth. Plants shall have well developed root systems and not be rootbound or show sunscald, injuries, abrasions or other objectionable disfigurements. Plants shall be free of disease, insects, pests, eggs, or larvae. Tree trunks shall be sturdy and well "hardened off". Plants not meeting these specifications shall be rejected.

Any plants delivered to the work site which are found to be not true to name or unsuitable in growth or conditions shall be removed from the site and replaced with acceptable plants. All plants shall be of the species, variety, size, age, and condition as specified herein or as shown on the Plans or described in the Special Provisions. Under no condition shall there be any substitution of plants or sizes for those listed on the Plans, except with the written consent of the Landscape Architect.

No plant shall be transported to the planting area that is not thoroughly wet throughout the root ball. Any plant that, in the opinion of the Agency, has a damaged root ball or is dry or in a wilted condition when delivered to the planting area will not be accepted, and shall be replaced by the Contractor at the Contractor's expense. Trucks used for transporting plants shall be equipped with covers to protect plants from windburn.

One plant of each bundle or lot shall be tagged with the name and size of the plant, in accordance with the standards of practice recommended by the American Association of Nurserymen.

All plant materials shall meet the specifications of Federal, State, and County laws requiring inspection for plant disease and insect infestations. Inspection certifications required by law shall accompany each shipment, invoice, or order for stock, and when such plants arrive at the site of the Work, the certificate of inspection shall be filed with the Agency.

Inspection of all plant material for acceptance shall be made at the project site at time of delivery. All plant material shall be approved by the Landscape Architect prior to installation. All rejected plant material shall be marked as such and removed from the project site immediately.

The Contractor shall notify the Agency at least two (2) days prior to the delivery of each shipment of plant materials. Plant materials shall be protected and maintained in good condition. Bare root and balled materials shall be watered regularly and placed in a cool area protected from sun and wind.

Plants shall be classified by type as to species, variety and genus and will be specified by scientific name conforming to the publication "Standard Plant Names" as adopted by the American Joint Committee on Horticultural Nomenclature. The plant materials to be planted will be shown on the Plans or specified in the Special Provisions.

50-43.14.A Turf

Grass sod shall be well established mown lawn grass turf and shall be free of weeds and any other harmful or deleterious matter.

At least eighty percent (80%) of the grass plants in the cut sod shall be composed of the species or varieties specified in the Special Provisions.

Grass sod shall be grown, inspected, and shipped in accordance with the provisions of the Agricultural Code of the State of California.

Sod shall be machine stripped or cut of a uniform soil thickness of one inch plus-or-minus one-quarter inch ($1" \pm 1/4"$). The measurement for thickness shall exclude top growth and thatch and shall be determined at the time of cutting in the field.

Sod shall be rolled or folded prior to lifting. Handling of sod shall be done in a manner that will prevent tearing, breaking, drying, or any other damage.

Sod shall be transplanted within twenty-four (24) hours from the time it is stripped, unless circumstances beyond the Contractor's control make storing necessary. In such case, sod shall be stacked, kept moist, and protected from exposure to the air and sun. The stored sod shall be installed in place not more than forty-eight (48) hours after cutting.

50-43.14.B Trees

Trees are classified by type as to genus, species, and variety as well as common name. The tree varieties to be planted shall be as shown on the Plans or described in the Special Provisions.

Tree species shall meet minimum size requirements for caliper size of trunk and height of tree stock or they shall be rejected. Table 50-8 below indicates the height to caliper of trunk relationship. Trees shall be specified by container size in the Contract, and shall meet the minimum height and caliper of trunk indicated in the table. For shade trees of recognized slower growth, as identified by the Agency, the height and caliper shall be not less than two-thirds ($2/3$) the height and caliper indicated below:

TABLE 50-8 TREE CALIPER-HEIGHT RATIO		
Container Size (gallons)	Caliper of Trunk (inches)	Average Height Range (feet)
5	3/8 to 1/2	4 to 5
5	1/2 to 5/8	5 to 6
7	5/8 to 3/4	6 to 7
7	3/4 to 1	7 to 8
7	1 to 1-1/4	8 to 9
15	1-1/4 to 1-1/2	9 to 10
15	1-1/2 to 1-3/4	10 to 12
15	1-3/4 to 2	12 to 14

In size grading of container grown trees, caliper measurement shall take precedence over height measurement, unless otherwise specified in the Special Provisions.

Caliper measurement shall be taken five inches (5") above soil level. If the tree is budded or grafted to a root system, the measurement shall be taken two inches (2") above the bud or graft union.

Trees to be planted as street trees shall be free of branches for approximately the lower half of their height.

Trees shall have reasonably straight stems and shall be well branched and symmetrical in accordance with their natural habits of growth. The branch system shall be free from dead or dry wood or broken terminal growth.

If possible, container grown trees shall be capable of standing upright without staking and shall have been grown in the container sufficiently long for the fibrous roots to have developed so that the root mass will retain its shape and hold together when removed from the container.

Trees shall not be rootbound or show evidence of girdling or kinked root systems. Trees shall not exhibit co-dominant trunks or branching with included bark. Trees shall not be severely topped or headed. Trees shall not have surface roots larger than one-quarter-inch (1/4") diameter. Trees shall not exhibit evidence of sunscald or pest infestation. Upon inspection, trees not meeting these requirements will be rejected.

The container shall be sufficiently rigid to protect the root mass during shipping.

At least one tree of each species or variety delivered to the work site shall be identified by scientific name and size on a legible waterproof label securely attached to the tree.

All trees shall be subject to inspection by the Agency at any time during the Project—at the place of growth, upon delivery, or during planting operations. However, such inspection shall not be construed as final acceptance or even conditional acceptance of such trees until completion of the Project.

The Contractor shall establish the necessary quality control and inspection practice to assure compliance with these specifications. The Contractor shall furnish a California Nursery Stock Certificate for each shipment of trees.

50-43.15 Water

Water shall be of such quality that it will promote germination of seeds and growth of plants.

50-43.16 Irrigation Pipe

Pipe and fittings for irrigation systems shall be as specified in these Specifications and the Special Provisions.

Unless otherwise shown on the Plans, risers and threaded nipples for irrigation systems shall be Schedule 80, PVC 1120 or PVC 1220, or PVC pipe conforming to the requirements of ASTM Designation: D 1785.

50-43.16.A Steel Pipe

For installation of backflow preventers, steel pipe and couplings and wrought iron couplings shall conform to AWWA standard C200 and the specifications of ASTM Designation: A 53, standard weight, galvanized, except that the weight of zinc coating shall be not less than ninety percent (90%) of the weight specified in said ASTM Designation. Fittings, except couplings, shall be galvanized malleable iron, banded and threaded, conforming to ANSI Standard: B16.3, 150 pound class.

Steel pipe below grade shall be wrapped with six (6) mil plastic tape.

50-43.16.B Plastic Pipe

Plastic pipe for irrigation systems will be shown on the Plans as main line and lateral line (non-pressure).

Solvent cement and primer for PVC plastic pipe and fittings shall be of commercial quality specifically manufactured for use with rigid PVC plastic pipe and fittings. The solvent cement and primer used shall be made by the same manufacturer. The color of the primer shall contrast with the color of the pipe and fittings.

The pipe shall be furnished in minimum standard lengths of twenty feet (20').

All plastic pipe shall be continuously and permanently marked with the following information—manufacturer's name, kind of pipe, material, size, NSF approved, and schedule or type.

The manufacturer shall also mark the date of extrusion on pipe. This dating shall be done in conjunction with records to be held by the manufacturer for two (2) years, covering quality control tests, raw material batch numbers, and any other information deemed necessary by the manufacturer.

50-43.16.B.(1) Main Line

Main line shall be PVC of the types and classifications shown or specified in the Contract. Main line shall be approved by the National Sanitation Foundation, and shall conform to the requirements of either ASTM Designation: D 2241 or D 2672, except that main line with a bell socket formed as an integral part of the pipe for use with rubber ring gaskets shall conform to the requirements of ASTM Designation: D 2241. The belled portion of said pipe for use with rubber ring gaskets shall conform to the requirements of ASTM Designation: D 3139 (except for the dimensional ratio), shall be formed to maintain uniformity in alignment and roundness and shall be free of irregularities and defects.

The wall thickness of the bell shall not be less than the specified minimum wall thickness of the pipe.

The wall thickness of the bell end of the pipe may exceed maximum allowable wall thickness of the pipe for a length not to exceed twenty-four inches (24") from the end of the pipe.

Main line and fittings on the pressure side of control valves that are two inches (2") or larger in diameter shall be either the rubber ring gasket type or the solvent cemented type, except that all pipe and fittings installed in conduits or sleeves shall be the solvent cemented type.

Threaded fittings and fittings to be solvent cemented to main line shall be injection molded PVC, Schedule 40. Fittings equipped with rubber ring gaskets for main line shall be either injection molded PVC plastic pipe fittings or machined pipestock fittings.

50-43.16.B.(2) Lateral Line

Lateral line shall be PVC of the type and classification shown on the Plans or specified in the Special Provisions. Lateral line shall be approved by the National Sanitation Foundation, and shall conform to the requirements of ASTM Designation: D 2241. PVC pipe shall be solvent weld, minimum Class 200, and shall be manufactured of Type 1, Grade I or II, 2000 psi design stress compound designated as PVC 1120 or 1220, and shall conform to ASTM Designation: D 1784 for rigid PVC compounds.

Fittings shall be molded fittings manufactured of the same material as the pipe and shall be suitable for either solvent weld or screwed connections. Solvent weld fittings shall be of a pressure rating equal to or greater than that of the pipe.

50-43.17 Subsurface Dripperline

Subsurface dripperline shall conform to Section 20-5.05A, "Subsurface Dripperline", of these Specifications and the Special Provisions. The dripperline shall consist of one-half inch (1/2") low density linear polyethylene tubing, housing internal, pressure compensating, self-cleaning, integral drip emitters.

The dripperline shall be available with two different emitter discharge rates. Low flow discharge rates shall range from .53 to .61 GPH. High flow discharge rates shall range from .92 to 1.02 GPH. Dripperline shall be available with twelve-inch (12"), eighteen-inch (18") and twenty-four inch (24") emitter spacing.

50-43.18 Irrigation Sleeving Conduit

Irrigation sleeving for irrigation line crossovers or control wire shall conform to Section 20—5.04B, "Irrigation Sleeving", of these Specifications and the Special Provisions.

Conduit shall be Schedule 40 PVC pipe. Conduit shall extend a minimum of twelve inches (12") beyond the back of all pavement.

50-43.19 Sprinklers and Emitters

Sprinklers and emitters shall be the type and model as noted on the Plans or as specified in the Special Provisions.

50-43.20 Automatic Irrigation Controllers

Automatic irrigation controllers shall be the type and model noted on the Plans or specified in the Special Provisions. Automatic irrigation controllers shall be fully automatic, with all solid state electronic components. The controller shall be rated for 117 volt, 60 cycle AC input and 26.5 volt, 2.2 amp output for continuous operation of 24 volt valves, with 14-day programming capability.

The controller shall be capable of manual station selection and operation. The controller shall have a 24-hour clock dial with one-hour increment starts. Each station shall have an "Off" switch for zero watering time and individual infinitely variable timing control for two- to sixty- (2- to 60-) minute station timing as well as an "On-Off-Repeat" switch for eliminating one or more stations from the timing sequence without changing timing dial setting. The 14-day clock shall provide maximum programming versatility.

The controller shall have the following standard features: an electrical circuit to operate a master valve, a reset circuit breaker to protect the controller from damage due to excessive voltage surges and a master "on-off" switch for turning controller "off" during rainy weather while allowing day and hour clocks to continue operation.

Irrigation controllers shall be housed in pedestal or wall-mounted enclosures as specified in the Contract.

Irrigation controllers shall conform to NEC Class 2 requirements. The controller output shall be less than 110 volt-amperes to qualify for direct burial of output wires.

The irrigation controller enclosure shall be constructed of stainless steel and shall be a minimum of thirty-six inches (36") high and twenty-four inches (24") wide and deep enough to house the components. Enclosure shall have a vented door and/or sides and shall be lockable. The enclosure shall be mounted on a concrete pad with a minimum dimension of thirty-six inches x thirty-six inches x six inches (36" x 36" x 6").

50-43.21 Quick Coupling Valves

Quick coupling valves shall be of brass or bronze construction with one-inch (1") IPS female pipe connections. The valve body shall be of two-piece construction, consisting of an upper and a lower piece body. The upper valve body shall be easily removable for replacement.

All quick coupling valves shall be the type used on nonpotable systems marked with special "Do Not Drink" warnings. Quick coupling valve shall have a durable locking rubber or vinyl cover, yellow in color. Purple covers shall only be used on systems using non-potable water.

All quick coupling valve keys shall be of the same manufacturer as the quick coupling valve, and shall be the proper size to fit the valves as specified. Valve key shall be of brass or bronze construction with a replaceable stainless steel lug.

50-43.22 Control Valves

Control valves shall be the electric remote control, battery-operated remote control or manual type straight or angle pattern globe valves, and shall be of glass filled nylon, plastic, brass, bronze, or cast iron construction as shown on the Plans or specified in the Special Provisions. All metal parts of glass filled nylon valves shall be stainless steel or brass. Valves shall be of the same size as the pipeline that said valves serve, unless otherwise shown on the Plans. Control valves shall be capable of withstanding a cold water working pressure of one hundred fifty (150) pounds per square inch.

Automatic valves shall have a manual flow control adjustment with shut-off provisions. The valves shall also have an external "bleed" to enable manual operation. Automatic actuation shall be by means of an encapsulated type solenoid with a minimum rating of 24 volts, 60 cycle and 2 to 5 watts.

50-43.23 Master Control Valve/Flow Sensor Assembly

Master Control Valve/Flow Sensor Assembly shall combine a turbine type (vertical impeller) water meter and a diaphragm actuated solenoid controlled valve mounted in a single globe style valve body. Master control valve shall be an electric normally open valve with a 24V solenoid. The main valve shall fully open and close drip tight in response to an electrical signal. The meter shall power a gear mechanism that activates a reed switch that transmits a pulse at a pre-determined amount of flow. Pulse transmitter shall be one pulse per ten (10) gallons through the master valve and flow sensor unit. The unit should include integral flow guides to eliminate the need for straight pipe allowances before and after the valve.

Maintenance operations on the valve and meter shall be feasible without removing the valve body from the line.

50-43.24 Valve Boxes

Valve boxes and valve box lids shall be precast portland cement concrete when installed in concrete or other paving. Valve boxes and valve box lids shall be reinforced plastic when installed in turf or planter areas. Concrete valve box lids shall be marked "IRRIGATION" in cast-in letters not less than one inch (1") high.

Valve boxes for control valves shall be 17" x 11-3/4" x 12" depth (minimum size) with 3" x 4" knock outs and installed two inches (2") above finished grade.

50-43.25 Backflow Preventers

Backflow preventers shall be reduced-pressure type as approved by the Sacramento County Environmental Health Division.

Backflow preventers shall have a bronze main valve body and relief valve body. Backflow preventers shall be factory-assembled and shall consist of two independently operating, center-guided, spring-loaded, “Y” pattern check valves, one hydraulically dependent differential relief valve, two (2) shut-off valves and four (4) test cocks. Pressure loss shall not exceed ten pounds per square inch (10 psi) at twenty (20) gpm.

Backflow preventers shall be the same size as the service line in which they are installed, unless otherwise shown on the Plans.

Protection blanket shall be provided for each device, and it shall be the appropriate size to fit the backflow prevention assembly specified. Fabric shall be a heavy-duty resin or vinyl coated 100% polyester plain weave. Fabric shall be water, mildew and flame resistant. Insulation shall be a layer of Radiant Barrier Foil (BF) consisting of a layer of polyethylene bubbles bonded to and sandwiched between two industrial strength foil sheets with a minimum R-value of R-9. This material is impervious to moisture and is unsuitable for rodent nesting material. Blanket shall have a water repellent lining of nylon fabric to resist tearing from backflow parts. Blanket shall be machine stitched with metal grommet reinforcement for installation of an individual lock. Blanket shall be forest green in color and have a manufacturer's five-year warranty.

50-43.26 Concrete

Unless otherwise specified in the Special Provisions, concrete for irrigation facilities shall be Class “B” concrete as specified in Section 50-5, “Portland Cement Concrete”, in this Section of these Specifications. Hand mixing of the concrete will be permitted.

50-43.27 Filter Assembly Units

Filter assembly units shall be as specified in the Special Provisions.

50-43.28 IPS Flexible PVC Hose

IPS flexible PVC hose shall be nonrigid polyvinyl chloride (nonrigid PVC) hose conforming to the specifications of ASTM Designation: D 2287, Cell-type 66404006.

The hose shall provide leak-free, non-separating connections suitable for the purpose intended when connected to the fittings specified herein. Flexible hose shall be algae resistant.

Fittings for flexible hose shall be injection molded PVC, Schedule 40, conforming to the specifications of ASTM Designation: D 2466. Fittings shall be solvent cemented type.

Solvent cement and primer for flexible hose and fittings shall be of commercial quality as specified for use with rigid PVC pipe and plastic pipe fittings.

50-43.29 Gate Valves

Gate valves shall be either flanged, threaded or ring type, iron or bronze body, bronze trimmed valves with rising (internally threaded) or non-rising stem, and shall withstand a cold water working pressure of one hundred fifty (150) pounds per square inch (psi). Gate valves shall be of the same size as the pipeline that the valves serve, unless otherwise shown on the Plans.

Gate valves three inches (3”) and smaller shall be bronze or brass. Gate valves four inches (4”) and larger shall be cast iron.

Ball valves at control valve assemblies shall be plastic.

Valve boxes for gate valves shall be ten-inch (10”) diameter with a bolt down lid and installed two inches (2”) above finished grade.

50-43.30 Air Vacuum Relief Valve

Air vacuum relief valve shall be non-corrosive plastic with one-half inch (1/2”) MPT threads. Maximum operating pressure of air vacuum relief valve shall be 140 psi. Valve shall eliminate negative pressure and vacuum within subsurface dripperline systems that may draw contaminants into the system.

50-43.31 Flush Valve Assembly

Flush valve shall be non-corrosive plastic with one-half inch (1/2") MPT threads. Maximum operating pressure of flush valve at ends of dripperline shall be fifty-seven (57) pounds per square inch (psi). Valve shall flush approximately one (1) gallon per cycle. Valve shall reduce sediment build-up within the dripperline system.

50-43.32 Unions

Unions shall be brass or malleable iron. All unions shall withstand the working pressure range requirements of the pipes with which they are used.

50-43.33 Irrigation Control Wires

Control wire for automatic control valves shall be #10, #12, or #14 as necessary for operation, shall be UL rated for direct burial, and shall be underground feeder type identified as (UF). Control wire shall have 4/64 inch (56 mils) minimum thickness of TW grade polyvinyl chloride insulation. Control wire shall be able to withstand a crush test of five thousand (5000) psi. Common or neutral conductors shall be white. The control wires to the automatic control valves shall be red. The spare wires shall be yellow.

Splices for control wire shall be specifically designed to insure waterproof underground direct bury wire connection, and shall be UL listed "Water Resistant Wire Connector Rated 60c, 600v for PVC insulated copper wires". Each connector shall consist of a crimp sleeve, base socket, sealing plug, and inert sealer.

50-43.34 Pull Boxes

Pull boxes for irrigation control wiring shall be No. 5 or larger unless otherwise shown on the Plans, and shall conform to these Specifications.

Pull boxes shall be precast portland cement concrete boxes with concrete covers, unless otherwise noted.

Pull box covers for pull boxes used solely for irrigation control wiring shall be marked "IRRIGATION" or "IRRIGATION CONTROL" in cast-in letters. Cover markings shall be clearly defined and uniform in depth and may be placed parallel to either the long or the short sides of the cover. Marking letters shall be between one inch (1") and three inches (3") high.

50-43.35 Pressure Gauges

Pressure gauges shall be hermetically sealed, water tight, and dust proof. Gauge shall be a two-inch (2") bottom-connected gauge with one-quarter-inch (1/4") brass standard pipe thread and shatterproof face. Gauge shall be rated for one hundred pounds per square inch (100 psi).

50-44 ENGINEERING FABRICS

Engineering fabrics shall conform to Section 88, "Engineering Fabrics", of the State Specifications.

50-45 PAINT

Unless otherwise specified in the Special Provisions, paint shall conform to Section 91, "Paint", of the State Specifications. Colors shall be as specified in the Contract.

50-46 LIQUID ASPHALT

Liquid asphalt shall conform to Section 93, "Liquid Asphalts", of the State Specifications.

50-47 ASPHALTIC EMULSION

Asphaltic emulsion shall conform to Section 94, "Asphaltic Emulsions", of the State Specifications and these Specifications.

Emulsified asphalt shall be Cationic type polymer modified grade PMCRS-2H.

The Contractor shall submit test results of the proposed emulsified asphalt, indicating compliance with these Specifications. Test results, including date of testing, of proposed emulsions and aggregate shall be submitted in writing to the Agency. Samples of the proposed emulsions and aggregate may also be requested by the Agency. The required tests shall conform to those specified in Section 94, "Asphaltic Emulsions", of the State Specifications, and the following:

TEST	TEST METHOD	REQUIREMENT
Viscosity @ 122°F	AASHTO T-59	100-250 sec.
Demulsibility	AASHTO T-59	60% - 95%
Penetration @ 77°F (100g 5 sec)	AASHTO T-49	40-65
Ductility @ 77°F (5 cm/min.)	AASHTO T-51	60 cm/min.
Percent Residue	Cal Test 331	65% min.
Torsional Recovery	Cal Test 332	18% min.
Oil Distillate (by volume of emulsion)	AASHTO T-59	3% max.
Solid Polymer Content (by weight)	Cal Test 401	2.5%
Ring and Ball Softening Point	AASHTO T-53 1-2	125°F min.

The binder shall conform to the aggregate with a ten percent (10%) minimum film stripping as tested by California Test Method 302.

The laboratory used to develop the job mix formula and to perform quality control shall meet the requirements of ASTM Designation: D 3666. A certification signed by the manager of the laboratory stating that it meets these requirements shall be submitted to the Agency prior to the start of work.

At the option of the Contractor, polymer shall be Neoprene, Ultrapave, or SBR. The polymer shall be added to either the asphalt or the emulsion at their locations of manufacture. The temperature of the polymer modified asphaltic emulsion at the time of application shall be between 130°F and 180°F.

The Contractor shall maintain a quality control system that will provide reasonable assurance that all materials submitted for use conform to these Specifications. The Contractor shall perform two (2) random samples each day, to verify compliance with the operations quality control. Samples shall be taken from the spray bar of the distributor truck at mid-load. The tests shown above shall be performed on each sample taken. The Agency reserves the right to suspend Contractor activities and reject the material until it can be shown that the material is in compliance with these Specifications.

If a sample of asphaltic emulsion taken during a Working Day does not conform to these Specifications, the price paid per ton for that day's production of asphaltic emulsion will be subject to the penalties listed for the nonconformities in the following table:

TABLE 50-9	
Nonconformity	Penalty
Viscosity is in excess of 75 seconds or less than 300 seconds.	5 percent deduction from the bid price per ton for emulsified asphalt
Torsional recovery exceeds 11 percent but is less than 18 percent.	5 percent deduction from the bid price per ton for emulsified asphalt
Torsional recovery is less than 11 percent.	10 percent deduction from the bid price per ton for emulsified asphalt

Test results shall be identified by the production date and time of sample and shall be submitted, in writing, to the Agency within two (2) Working Days of the sample date. The Agency reserves the right to witness the quality control testing performed by the testing lab and to test any material at any time during the course of the Work.

Each distributor truck shall be equipped, at all times, with the proper measuring stick and calibration card. On-site calibration of distributor trucks, for determining actual spread rate of asphaltic emulsion, shall be performed when directed by the Agency. The asphaltic emulsion shall be stored in heated circulation tanks at controlled temperatures, between 140°F and 180°F, for a period not to exceed seven (7) days. The temperatures of the asphaltic emulsion shall be between 130°F and 180°F at the time of application.

50-48 EPOXY

Epoxy shall conform to Section 95, "Epoxy", of the State Specifications.