

SECTION 712 - MISCELLANEOUS

712.01 Water. Water used in mixing and curing concrete, mortar and grout shall be clean and free from injurious quantities of deleterious substances. Deleterious substances include oil, acid, alkali, salt, organic matter, and vegetable matter. The Contractor shall test water of doubtful quality by comparison with distilled water by standard portland cement tests for time of set and mortar compressive strength. A change in the setting time of more than twenty-five (25) percent will be sufficient cause for rejection. Also, a change in the setting time of a reduction of more than five (5) percent in the compressive strength of mortar at fourteen (14) days may be cause for rejection.

Water for curing concrete shall have a pH value higher than five (5). Also, water for curing concrete shall not contain impurities in a sufficient amount to cause discoloration of concrete or produce etching of the surface.

The Contractor may use water reclaimed from mixer wash out operations in mixing concrete provided the Contractor makes the water up from a dilution type process. The Contractor shall not make water up from a concentration type process. A dilution type process keeps solids in a state of suspension when extensively diluting and continually agitating the reclaimed water. Such water shall not contain coloring agents or more than three hundred (300) parts per million of alkalies ($\text{Na}_2\text{O} + 0.658\text{K}_2\text{O}$) determined on the filtrate. The specific gravity shall not exceed 1.03 nor vary more than ± 0.010 .

When requested by the Engineer, the Contractor shall submit evidence based on tests made by an accepted laboratory.

The Engineer may accept water accepted by the county for drinking purposes without testing. The Engineer may waive the requirements for testing water for mixing and curing purposes if the Engineer considers the water satisfactory for that purpose.

712.02 Epoxy-Resin System. Epoxy-resin system shall be a two (2) component, one hundred (100) percent solid, non-sag, moisture-insensitive adhesive, conforming to ASTM C 881, Type II, Grade 3, Class C. The Contractor shall make this system for use in a neat form for vertical or overhead bonding and embedment.

The epoxy material components shall conform to the following:

(A) Component "A". Component "A" shall have an epoxide equivalent of 220-250 and the reactive resin portion shall be a minimum of eight-five (85) percent.

(B) Component "B". Component "B" shall be a reaction product of one (1) mole of an aliphatic polyamine and two (2) moles of monofunctional epoxide. The epoxide contains compounds modified with aliphatic amine adduct and viscosity control agents.

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The component ratio of "B" to "A" shall be 1:2 by volume.

The mixed components shall conform to the following requirements:

Solid Content	100 percent by weight
Pot Life	20-30 minutes at 73°F
Tack-Free Time (Thin Film)	2-4 hours at 73°F
Final Cure ASTM D 695 (neat) (75 percent ultimate strength)	3 days at 73°F
Initial Viscosity	Similar to petroleum jelly

The cured neat binder shall conform to the following requirements:

Tensile Strength ASTM D 638	3000 psi minimum at 14 days, 73°F cure
Tensile Elongation ASTM D 638, Modified	1/2 - 2 percent at 14 days, 73°F cure
Compressive Strength ASTM D 695	9000 psi minimum at 28 days, 73°F cure
Compressive Modulus ASTM D 695	360,000 psi minimum at 28 days, 73°F cure
Water Pick-up ASTM D 570	1.0 percent maximum

The Contractor shall furnish notarized certification to the Engineer that the material proposed for use meets the above requirements. *|

712.03 Hydrated Lime. Hydrated lime shall conform to ASTM C 207, Type N. *|

712.04 Grout.

(A) Non-Shrink Grout. Non-shrink grout shall be a ready to use grout mix to support structural members. The grout shall evenly distribute the forces of vibration, impact and thrust generated in operation or use. Also, the grout shall maintain the precise level and alignment of the grouted members. Also, the grout shall fill the required volume with no gaps or voids and shall flow so that the Contractor can pump the grout. The admixtures to the grout shall be non-metallic and the grout shall not rust or corrode. *| *| *| *| *|

The grout shall have a portland cement base, with an expansive agent and carefully graded silica sand. The Contractor shall package *| the grout in fifty (50) pound multi-wall bags with polyethylene liners. *|

The grout shall meet the following characteristics:

Yield	0.8 cubic feet per 100 pound
Initial Set	Approximately one hour at 68-72°F
Final Set	Approximately 5 hours
Work Time	50 to 60 minutes

Compressive Strength shall meet the following requirements:

Age (days)	Compressive Strength (psi)	Expansion (percent)
1	1700	-
3	4300	-
7	6000	-
28	8900	0.0002

Testing for compressive strength shall conform to ASTM C 109 - Mortar Sand.

The Contractor shall mix the grout only with the addition of clean *| water. The Contractor shall use and not drypack the grout in mixed form *| only.

The Contractor shall mix the grout at a rate of half (1/2) to *| three-quarters (3/4) gallon of water to fifty (50) pound bags to give a *| four (4) inch slump. For pumpable mixture, the Contractor shall mix *| the grout to give slightly more than four (4) inch slump. The Contractor *| shall adjust the water content to suit field conditions. *|

(B) **Epoxy Grout.** Epoxy grout shall be a two (2) component, one hundred (100) percent solids, moisture-insensitive, epoxy-resin system made for use as a high strength grout for anchor bolts when mixed with aggregate and shall meet the following requirements:

PROPERTIES OF NEAT MATERIAL	
Tensile Strength ASTM D 638	3,500 psi min. @ 14 days, 73°F cure
Tensile Elongation ASTM D 638 modified	1/2 - 2 percent @ 14 days, 73°F cure
Compressive strength ASTM D 695	12,500 psi min. @ 28 days, 73°F cure
Compressive modulus ASTM D 695	470,000 psi min. @ 28 days, 73°F cure
Compressive strength ASTM D 695	5,500 psi min. @ 24 hours, 73°F cure
Water pick-up ASTM D 570	1.5 percent maximum

The Contractor shall furnish notarized certification to the Engineer that the material proposed for use meets the above requirements and those of ASTM *| C 881, Type III, Grade 1, Class C. *

712.05 Precast Concrete Curb and Gutter. Precast concrete curb and gutter include portland cement concrete units. The Contractor shall construct them *| to the lengths, shapes and other details shown in the contract. The Contractor *| shall reinforce these units with steel reinforcement if shown in the contract. *| Steel reinforcement shall conform to Subsection 709.01 - Reinforcing Steel. *

If required for driveways, crossings, or closures, the Contractor shall *| furnish a depressed or modified section of curb according to the contract or *| ordered by the Engineer. *

The precast curb and gutter blocks shall be cast in wood or metal forms. *| The Contractor shall pour the faces of the curb and gutter exposed in the *| completed work against smooth surfaced metal or wood forms. Also, the *| Contractor shall pour the back face of curbs to a depth of two (2) inches *| against smooth surfaced metal or wood forms. *

The Contractor shall not remove the precast curb and gutter blocks from *| the forms earlier than twenty-four (24) hours after casting. The Contractor *| shall cure precast curb and gutter blocks for three (3) days after casting. *

The Contractor shall not handle the precast curb and gutter blocks *| roughly nor place the precast curb and gutter blocks in position before seven *| (7) days after casting. *

712.06 Precast Concrete Units.

(A) **Precast Reinforced Concrete Manhole Risers and Tops.** Precast reinforced concrete manhole risers and tops shall be according to the contract and ASTM C 478. *|

(B) **Pullboxes.** Pullboxes shall be precast reinforced concrete boxes according to the contract. Portland cement concrete shall be Class B *| according to Section 601 - Structural Concrete. Reinforcing steel shall *| conform to Section 602 - Reinforcing Steel. *|

The Engineer may permit other materials in pullbox designs. The *| Contractor shall furnish detailed description, specifications, and data, *| to show that the new design is equal to or better than specified. The *| Contractor shall prove its equality. *|

712.07 Frames, Grates, Covers and Ladder Rungs. |

(A) **Frames and Covers.** Frames and covers shall be of cast iron and shall conform to ASTM A 48, Class No. 30. *|

The Contractor shall make the castings accurately to the dimensions *| shown. The Contractor shall machine the castings where necessary to *| secure flat and true surfaces. The Contractor shall make allowance in *| the patterns so that the finished castings shall have the specified dimensions.

Castings shall be tough, close-grained, gray iron; sound, smooth and *| clean; and free from blisters, blowholes, shrinkage and cold shuts.

The cover of the bearing faces of the frames and covers shall lay *| flat in normal positions on the frame and have snug fit. *|

The Contractor shall clean the castings thoroughly and paint the *| castings with one (1) coat of high-grade asphaltum before leaving the *| shop.

(B) **Frames and Grates.** Frames and grates shall be of cast iron conforming to the same requirements specified for frames and covers unless the contract specifies steel. *|

If the contract specifies steel, frames and grates shall conform to *| ASTM A 283, Grade D, ASTM A 27 Grade 65-35, or ASTM A 47, Grade 35018. *| The Contractor shall zinc-coat the frame and grates according to ASTM A *| 123. *|

If the contract specifies reinforcing steel, the grates shall *| conform to Section 709 - Reinforcing Steel and Wire Rope. The Contractor *| shall clean thoroughly and paint the grates with one (1) coat of high- *| grade asphaltum at the shop and a second coat after installation.

Fabricated members shall be true to line and free from twists, bends and open joints. The Contractor shall not splice members. The Contractor shall make cut surfaces and edges smooth by machining or grinding before fabrication. *|
*|
*|

The sizes and lengths of welds shall be more than those specified in the contract. Also, the welds shall not be substantial over the contract requirements. |

(C) Ladder Rungs.

(1) Water Valve Manholes. Water valve manhole rungs shall be either three-quarters (3/4) inch in diameter, hot-dipped zinc-coated carbon steel, or stainless steel, Type 302, 304, or 315. *|
*|
*|

The Contractor shall make rungs according to the contract. *|

(2) Sanitary Sewer Manholes. The Contractor shall make rungs of sewer manholes according to the contract. *|
*|

The Contractor shall make top rungs from either one (1) inch diameter wrought iron bars conforming to ASTM A 36 or three-quarters (3/4) inch diameter stainless steel bars, Type 302, 304 or 316. *|
*|
*|

The Contractor shall hot-dip zinc-coat the wrought iron rungs after fabrication. *|

Other rungs shall be either cast iron conforming to ASTM A 48 or ductile iron conforming to ASTM A 439. The Contractor shall clean cast iron and ductile iron rungs thoroughly and paint them with two (2) coats of bitumastic or hot asphalt. *|
*|

(3) Storm Drain Manholes. Rungs for storm drain manholes shall conform to water valve manholes. |

(D) Eye Bolts, Nuts, and Washers for Type "A" Water Manhole. Eyebolt shall be one (1) inch diameter, six (6) inches long, zinc-coated and with one (1) inch eye. Washer shall be quarter (1/4) inch by six (6) inch by six (6) inch steel plate. The Contractor shall zinc-coat the nuts American Standard heavy cold-punched hexagon nuts. *|
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712.08 (Unassigned)

712.09 Bearing Devices and Related Materials.

(A) Red Primer Paint for Bedding Masonry Plates. Red primer paint shall conform to Subsection 708.01(A). *|

(B) Sheet Lead. Sheet lead shall conform to ASTM B 29, Common De-silverized Lead A. The sheets shall be of uniform thickness and free from cracks, seams, slivers, scale and other defects. Lead sheets shall |

be one-eighth (1/8) inch in thickness with a permissible tolerance of \pm 0.03 inch.

(C) **Lead Plate.** The Contractor shall roll the lead plate from pig lead made from ore or other material by process of reduction and refining. The Engineer will not permit the use of reclaimed lead. The material shall contain a minimum of 99.85 percent of lead and shall conform to ASTM B 29.

(D) **Preformed Fabric Pads.**

(1) **Pads Under Railing Posts.** The preformed fabric pads includes:

(a) multiple layers of eight (8) ounce cotton duck impregnated and bound with high-quality natural rubber or

(b) equivalent and equally suitable materials compressed into resilient pads of uniform thickness.

The number of plies shall produce the specified thickness, after compression and vulcanizing. The finished pads shall withstand compression loads of more than ten thousand (10,000) pounds per square inch without detrimental reduction in thickness or extrusion. The finished pads shall be perpendicular to the plane of the laminations.

(2) **Pads Under Bridge Bearings.** The preformed fabric pads include multiple layers of cotton duck impregnated and bound with rubber, compressed into resilient pads of uniform thickness according to Federal Specifications MIL-D-882D. The number of plies shall produce the specified thickness after compression and vulcanizing. The finished pads shall withstand compression loads of more than ten thousand (10,000) pounds per square inch without detrimental reduction in thickness or extrusion. The finished pads shall be perpendicular to the plane of the laminations.

(E) **Elastomeric Bearing Pads.** The Contractor shall not laminate the elastomeric bearing pad three-quarters (3/4) inch and less in thickness. The Contractor shall laminate pads over three-quarters (3/4) inch in thickness.

Laminated pads include alternate laminations of elastomer and metal or elastomer and fabric bonded together.

The outside laminations shall be metal or fabric. The Contractor shall coat the outside and edges of metal laminations with elastomer less than one-eighth (1/8) inch in thickness.

Lamination of elastomer shall be half (1/2) inch \pm one-eighth (1/8) inch in thickness. Variation in thickness of an individual elastomer lamination shall not exceed one-eighth (1/8) inch within the width or

length of a pad. The variation in thickness of elastomer lamination *|
 within a pad shall be such that each metal or fabric lamination shall not *|
 vary by more than one-eighth (1/8) inch from a plane parallel to the top *|
 or bottom surface of the pad.

The total out to out thickness of a pad shall not be less than nor *|
 more than one-fourth (1/4) inch greater the thickness shown in the *|
 contract. *|

Variation of total thickness within an individual pad shall not
 exceed one-eighth (1/8) inch.

The length and width of a pad shall not vary more than one-eighth
 (1/8) inch from the dimensions shown in the contract. |

Pads containing metal laminations and pads shown as beveled in the
 contract shall be full molded. The Contractor may cut the pads of *|
 elastomer or with fabric laminations from large sheets. The Contractor *|
 shall cut the pads to: *|

- (1) avoid heating of the material, *|
- (2) produce a smooth edge with no tears or other jagged areas, and *|
- (3) cause as little damage to the material as possible. *|

The Contractor may round the corners and edges of molded pads. *|
 Radius at corners shall not exceed three-eighths (3/8) inch. Radius of *|
 edges shall not exceed one-eighth (1/8) inch. *|

If the Contractor is testing a sample for separation according to *|
 Hawaii Test Method HWY-TC 13, the bond between elastomer and metal or *|
 fabric shall have a minimum peel strength of thirty (30) pounds per inch. *|

The Contractor shall weave the fabric reinforcement from one hundred *|
 (100) percent glass fibers of "E" type yarn with continuous fibers. The *|
 minimum thread count in either direction shall be twenty-five (25) *|
 threads per inch. The fabric shall have a crowfoot or an eight (8) *|
 Harness Satin weave. Each ply of fabric shall have a breaking strength *|
 of more than eight hundred (800) pounds per inch of width in each thread *|
 direction. The Contractor shall test a three (3) inch by thirty-six (36) *|
 inch samples on split drum grips. Fabric reinforcement shall be single *|
 ply at top and bottom surfaces of the pad and double ply within the pad. *|
 The bond between double plies shall have a minimum peel strength of *|
 twenty (20) pounds per inch.

The elastomeric laminations for the rubber shall be more than sixty *|
 (60) percent (by volume) neoprene. *|

The elastomer, as established from test specimen, shall conform to the following:

ORIGINAL PHYSICAL PROPERTIES	
Hardness, ASTM D 2240	60 \pm 5
Tensile strength, minimum psi, ASTM D 412	2,500
Elongation at break, minimum %	350
ACCELERATED TESTS TO CONCLUDE LONG-TERM AGING CHARACTERISTICS, OVEN AGED - 70 HOURS/212 DEGREES FAHRENHEIT, ASTM D 573	
Hardness, points change, maximum	0 to \pm 15
Tensile strength, % change, maximum	\pm 15
Elongation at break, % change, maximum	-40
OZONE - 1 PPM IN AIR BY VOLUME - 20% STRAIN - 100 \pm 2 DEGREES FAHRENHEIT, ASTM D 11491	
100 Hours	No cracks
COMPRESSION SET - 22 HOURS/158 DEGREES FAHRENHEIT, ASTM D 395 - METHOD B	
25 percent Maximum	
LOW TEMPERATURE STIFFNESS - ASTM D 797	
Young's Modulus, 10,000 psi maximum at 40 degrees Fahrenheit	
TEAR TEST - ASTM D 624 - DIE C	
250 pounds per linear inch minimum	
¹ Samples to be solvent wiped before test to remove traces of surfaces impurities.	

Specimens tested shall show no deterioration of elastomer or bond *
between the elastomer and metal or fabric reinforcement laminations. The *
Contractor shall test them according to Hawaii Test Method HWY-TC 13 for *
ten thousand (10,000) cycles at eight hundred (800) pounds per square *
inch and half (1/2)t (t=total thickness of elastomer) translation. The *
testing speed shall not exceed four and half (4-1/2) inches per minute. *

The Contractor shall submit to the Engineer certified test results certifying compliance of the elastomeric pads according to the contract. *
The Contractor shall submit the certificates before installing of the elastomeric pads. |

The adhesive used to secure the pad to the concrete shall be as recommended by the manufacturer and accepted by the Engineer. *

(F) Bronze and Stainless Steel Bearing and Expansion Plates. Bronze and stainless steel bearing and expansion plates shall be according to the contract. The bearing and expansion plates shall be of a type in standard production by an established manufacturer of that equipment. *
*

The bronze bearing plate shall conform to ASTM B 22, Alloy B and shall be of the self-lubricated type. The Contractor shall provide bronze bearing plates with trepanned recesses (not grooves) filled with a lubricating compound to withstand the atmospheric elements. Also, the bronze bearing plates include graphite and metallic substances with a lubricating binder. The Contractor shall press the compound into the recesses by hydraulic presses to form dense non-plastic lubricating inserts. Shellac or other non-lubricating binder material will not be acceptable. The lubricating area shall: *

(1) include more than twenty-five (25) percent of the total area, *

(2) have a capacity of more than two thousand five hundred (2,500) pounds per square inch of bearing, and *

(3) provide a coefficient of friction for bronze on stainless steel of not more than 0.1 for a load of two thousand five hundred (2,500) pounds per square inch. *

The Contractor shall finish the contact surfaces in the direction of motion and shall conform to ANSI B 46.1, No. 125. *

Masonry and sole plates shall be stainless steel according to ASTM A 743 and ASTM A 744. The Contractor shall finish the sliding surfaces and surfaces in contact with the bronze bearing plate in the direction of motion. They shall conform to ANSI B46.1, No. 125. *

712.10 Zinc-Coating. Zinc-coating shall conform to ASTM A 123 or ASTM A 153. *

712.11 Abrasive Coating. Abrasive coating for slip resistant concrete includes aluminum oxide. The size of grain shall be No. 8 - No. 16. Freezing, moisture, and cleaning compound shall not affect the abrasive coating. *

712.12 Sprinkler Heads. Sprinkler heads shall be of the size, type and operating characteristics shown in the contract. The sprinklers shall be as follows: *

(1) Lawn type sprinkler heads, shrubbery heads, and bubbler heads shall have plastic or brass bodies with adjustable spray.

(2) Lawn pop-up sprinkler heads shall have plastic or brass bodies with machined plastic or brass internal parts and adjustable spray. The pop-up portion of the head shall return freely after operation on a thirty (30) degrees incline with the horizontal.

(3) The Contractor shall construct jet sprinkler heads of plastic, *| brass, bronze, stainless steel or combination of the above. Nozzles *| shall be precision machined plastic or brass and shall be removable and interchangeable. Sprinklers shall be the impact or gear driven type and shall operate smoothly without stalling while under the specified operating pressure.

Arms or lever shall be brass, bronze or anodized aluminum.

Part circle heads shall have adjustable arc stops that are positive locking.

(4) Rotary pop-up sprinklers shall be of the same construction as the jet sprinklers. Casing shall be plastic, brass, bronze, cast-iron or aluminum with non-corrosive coating. Cover shall be brass, bronze or aluminum. Part circle heads shall have adjustable arc stops that are positive locking. Working parts shall operate smoothly without stalling *| while under the specified operating pressure. Internal parts shall be removable from the top.

If shown or ordered by the Engineer, jet sprinklers and rotary *| pop-up sprinklers for part circle sprinkling shall have an anti-splash *| device. *|

(5) The Contractor shall construct the nozzle sprinkler heads of a *| plastic or brass material.

--(6) Emitters shall be a pressure compensating emitter. They shall *| deliver from 0.9 gallon per hour at ten (10) pounds per square inch to *| 1.7 gallon per hour at forty-five (45) pounds per square inch ± five (5) *| percent). *|

The emitter shall use the vortex principle of flow regulation. The *| Contractor shall tether the exit plug to the emitter body. *|

The Contractor shall equip the emitter body with an inlet barb that *| the Contractor shall insert directly into the plastic pipe (irrigation *| line). *|

The Contractor shall be responsible in deciding the proper hole size *| and method of making the hole to get a leak free connection at operating *| pressure. The Contractor shall remove and replace the emitters that leak at *| the barb. Also, the Contractor shall remove and replace a minimum of twelve *| (12) inches of irrigation line on each side of the emitter location. *|

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If two (2) or more consecutive emitters leak at the barb, the Contractor shall remove and replace the entire irrigation line between these two (2) points. *|
*|
*|

The emitter shall be field disassembled without the aid of tools. *|

712.13 Valves.

(A) **Quick Coupling Valves and Keys.** Quick coupling valves shall be two (2) piece body with self-closing cap for one hundred fifty (150) pounds per square inch service rating. Except the cap, quick coupling valves shall be of brass or bronze construction.

Keys or coupler for use with quick coupling valves shall be brass, bronze, stainless steel or corrosion resistant metal or combinations of the above.

(B) **Garden Valves.** Garden valves shall be straight nose type of brass or bronze construction, with replaceable compression disks. Handles shall be brass, bronze or steel.

(C) **Manual Control Valves.** Manual control valves shall be the manual type straight or angle pattern globe valves. They shall be brass or bronze construction with replaceable compression disks and shall be of the same size as the pipeline that said valves serve. Control valves shall withstand a working pressure of one hundred fifty (150) pounds per square inch. Handles shall be brass, bronze or steel. *|

(D) **Gate Valves.** Gate valves shall be: *|

(1) flanged, threaded or ring type, *|

(2) iron or bronze body, *|

(3) bronze trimmed valves with rising (internally threaded) or non-rising stem. *|
*|

Also, they shall withstand a cold water working pressure of two hundred (200) pounds per square inch. Handles shall be brass, bronze or steel for valves three (3) inches or smaller, and shall be two (2) square operating nut for larger valves. *|

(E) **Valve Assembly Unit.** Valve assembly unit includes: *|

(1) a control valve, *|

(2) pressure regulator, *|

(3) filter, *|

- (4) two (2) pressure gages, and *
- (5) concrete or plastic valve box. *

The Contractor shall make the pressure regulator body of brass or bronze. The pressure regulator shall withstand a working pressure of one hundred fifty (150) pounds per square inch. The Contractor shall equip the pressure regulator with a union. The Contractor shall regulate the pressure regulator between thirty (30) and forty (40) pounds per square inch.

The Contractor shall make the filter body of reinforced polypropylene plastic. The filter shall withstand a working pressure of one hundred twenty-five (125) pounds per square inch. Also, the Contractor shall equip the filter with a removable cartridge type filter. The filter body shall be cylindrical in shape, about five (5) inches in diameter, twelve (12) inches long and shall have three-quarters (3/4) inch NPT connections.

The filter cartridge shall be disposable. The Contractor shall groove and make the filter cartridge monolithically (without a center core support) of white cellulose melamine resin. The cartridge shall withstand a differential pressure of seventy (70) pounds per square inch and shall operate at a maximum temperature of two hundred ten (210) degrees Fahrenheit. The cartridge shall have a fifty (50) micron rating.

The Contractor shall make the pressure gage case and window of polycarbonate resin. The gage shall be:

- (1) one and a half (1-1/2) inches in diameter, *
- (2) calibrated from zero (0) to sixty (60) pounds per square inch in two (2) pound increments, and *
- (3) complete with a black aluminum pointer. *

(F) Remote Control Valves. The Contractor shall provide the electric remote control valves with a straight or angle pattern of either brass or bronze. The valves shall have a minimum pressure of one hundred fifty (150) pounds per square inch. Also, the Contractor shall:

- (1) normally close the valves and the valves shall be the size shown in the contract. *
- (2) ensure that the valves are completely serviceable from the top without removing the valve body from the system. *
- (3) equip the valves with a device that will regulate and adjust the flow of water and provide the valves with a manual shutoff. *

(4) ensure that the automatic closing time is more than five (5) *|
seconds. *|

(5) make the valves by the same company as the electric automatic *|
controller or master-satellite controller. *|

(6) design the valve solenoid for operation on a twenty-four (24) *|
to thirty (30) volt, AC circuit. *|

(7) install the valves with a union on the discharge side of the *|
valve. Valves with a union as part of the mainbody will be *|
acceptable. *|

(G) **Check Valves.** Check valves shall be the diaphragm type, globe
pattern and hydraulically operated. The body and cover shall be cast
iron with brass or bronze operating parts. The maximum working pressure *|
shall be one hundred seventy-five (175) pounds per square inch. Valve *|
shall be for screwed or flanged pipe connection. *|

(H) **Pressure Relief or Sustaining Valve.** The pressure relief or
sustaining valve shall be hydraulically-operated, pilot-controlled,
diaphragm type, globe or angle pattern valve. Valve body and cover shall
be cast iron, brass or bronze with brass or bronze operating parts. The *|
maximum working pressure shall be one hundred seventy-five (175) pounds *|
per square inch. Valve shall be for screwed or flange connection. One |
(1) inch and smaller valves shall be spring loaded. *|

The pressured relief or sustaining valve shall maintain a constant
upstream pressure by bypassing or relieving excess pressure. Valve shall
operate at ten (10) percent above the relief pressure shown in the *|
contract. *|

(I) **Pressure Reducing Valve.** The pressure reducing valve shall be
hydraulically operated, pilot-controlled diaphragm type, globe or angle
-valve. The maximum working pressure shall be one hundred seventy-five *|
(175) pounds per square inch. Valve body and cover shall be brass, *|
bronze or cast iron with brass or bronze operating parts. *|

The pressure reducing valve shall maintain a constant outlet
pressure despite the fluctuating inlet pressure. Valve shall operate *|
at the discharge pressure shown in the contract. *|

(J) **Air Relief Valve.** The valve shall be of cast iron, brass or bronze
body and cover with bronze trim, stainless steel floats and shockproof
synthetic seats for three hundred (300) pounds per square inch maximum
pressure. Valve shall be rated for one hundred and fifty (150) pounds
per square inch service.

The Contractor shall paint the air relief valves with two (2) coats *|
of asphalt varnish according to Federal Specifications TT-V-51F. *|

(K) **Anti-Drain Check Valve.** The anti-drain check valve shall be spring loaded adjustable check valve. Valve shall be Schedule 80 PVC virgin material and rated at two hundred (200) pounds per square inch. Valve shall be preset at the factory at five (5) pounds per square inch.

712.14 Pressure Regulators. The Contractor shall make pressure regulators in brass or bronze body. Also, the Contractor shall design for non-shock cold water inlet (up to 140 degrees Fahrenheit) pressure of one hundred fifty (150) pounds per square inch. The Contractor shall equip the pressure regulator with a union and integral strainer. The pressure regulator shall regulate the pressure within the ranges shown in the contract.

712.15 Backflow Preventers. Backflow preventers shall conform to the governing agency concerned. Backflow preventer shall be of the same size as the pipeline connected. Also, they shall have a service rating of one hundred fifty (150) pounds per square inch for non-shock cold water (up to 140 degrees Fahrenheit).

712.16 (Unassigned)

712.17 Planting Soil. Planting soil includes soil passing the half (1/2) inch screen that is fertile and friable of loamy character containing a normal quantity of organic matter to sustain healthy plant growth. The planting soil shall:

- (1) be obtained from well drained arable land,
- (2) be free from refuse, stumps, roots, heavy or stiff clay, coarse sand, noxious seeds, sticks, brush, litter and other material that would be undesirable to the proper development of vegetative growth, and
- (3) be free from abnormal quantities of acid or alkaline elements, nematodes, or toxic compounds.

-Red humic latosol soils or types known as "Palolo Clay" or "Lualualei Clay" are not acceptable.

The Contractor shall submit a typical sample of the planting soil proposed for use on the project for acceptance. The Contractor shall provide fertilizers and amendments required to attain the nutrient level recommended by Engineer at no cost to the State. Upon delivery, the Engineer reserves the right to reject the material if the planting soil is not according to the accepted sample.

712.18 Fertilizer.

(A) **Commercial Fertilizer.** Mixed commercial fertilizer shall be a complete fertilizer, shall bear manufacturer's guaranteed statement of analysis, and shall conform to the following minimum requirements in available form:

- (1) For first application,
- (a) Granular Fertilizer (for broadcasting over large areas)
- 16 percent Nitrogen,
16 percent Phosphoric Acid and
16 percent Potash, or
- (b) Fertilizer Tablets (For confined plantings of individual plants)
- (2) For subsequent applications,
- 10 percent Nitrogen,
30 percent Phosphoric Acid, and
10 percent Potash.

If commercial fertilizer of the above formulas is not available, the Contractor may furnish as a substitute, fertilizer with an equivalent formula upon request. The Contractor shall furnish the fertilizer in new, clean, sealed and properly labeled bags. The Contractor shall protect the fertilizers delivered on the job properly from the weather.

(B) **Manure.** Manure shall be barn or stable type that shall be either horse or cattle droppings and shall be more than three (3) months and less than two (2) years old.

712.19 Stakes, Guy Wires, Turnbuckles and Markers.

(A) Stakes.

(1) **Wood Stakes.** Wood stakes shall be about two (2) inches square by eight (8) feet, construction grade Redwood. The Engineer will permit a tolerance of quarter (1/4) inch in the cross-sectional dimensions. The Contractor shall sharpen the wood stakes at one end.

(2) **Iron Pipe Stakes.** Iron pipe stakes shall be three-quarters (3/4) inch iron pipe and more than three (3) feet long.

(3) **Reinforcing Steel Stakes.** Reinforcing steel stakes shall be three-quarters (3/4) inch round reinforcing steel rods and more than three (3) feet long.

(B) **Guy Wire.** Guy wire shall be No. 11 gage zinc-coated steel wire for trees three (3) inches in diameter or less. Guy wire shall be No. 9 gage for trees over three (3) inches in diameter. Wires shall be new and free from bends or kinks.

(C) **Turnbuckles.** Turnbuckles used in bracing trees shall be zinc-coated steel of the size shown in the contract.

(D) **Markers.** Markers for the house connection reducer (sewer system) shall be two (2) inch square redwood of the required length.

712.20 Signs.

(A) General.

(1) **Reflectorization.** The Contractor shall reflectorize the following according to the contract:

(a) background for illuminated guide signs and exit number panels ("E" designation) with Type III or IV retroreflective sheeting.

(b) background for non-illuminated guide signs and exit number panels ("D" designation) with Type III or IV retroreflective sheeting.

(c) messages, arrows, and borders of guide signs and exit number panels ("E" and "D" designations) with Type III or IV retroreflective sheeting or with acrylic plastic reflex reflectors on porcelain enameled aluminum cut-outs.

(d) regulatory and warning signs, directional signs ("DIR" designation) route and auxiliary markers, shield symbols, yellow "EXIT ONLY" panels, construction warning signs, and barricade rails completely with Type III or IV retroreflective sheeting.

(2) **Embossing.** The Contractor shall raise the details from the background more than 0.10 inch and less than 0.125 inch. The finished embossing shall conform to the lines in the contract, clear and even in outline, and free from cracks or tears. The entire sign shall be free from twist or buckle. The background shall be a plane surface.

The Contractor shall keep the standard warehouse blank free from dust and grease. The standard warehouse blank shall have an alodine coating. The Contractor shall wipe the standard warehouse blank clean before applying the film message. The metal surfaces shall be free of defects resulting from fabrication.

The Contractor shall treat the mill finish blanks by the following process before applying the message film:

(a) Vapor degreasing by total immersion of sign panel in a saturated vapor of trichloroethylene for a minimum of one (1) minute.

(b) Etching by immersion for five (5) minutes in an eight (8) percent solution of phosphoric acid at one hundred twenty (120) degrees Fahrenheit.

(c) Rinsing by spraying with cold running water, followed by immersion for one (1) minute in circulating hot water at a temperature between one hundred sixty (160) and two hundred (200) degrees Fahrenheit.

(d) Placing in forced warm-air drying tank for one (1) minute.

(B) Backing.

(1) **Sheet Aluminum.** The minimum sheet aluminum thickness for signs shall be: *

(a) 0.063 inch for signs three (3) square feet or less; *

(b) 0.080 inch for signs 3 square feet to 6.25 square feet; *

(c) 0.100 inch for signs over 6.25 square feet and R1-2 "Yield" signs. *

Aluminum sheet shall conform to ASTM B 209, alloy 6061-T6 flat sheet.

Backings for signs four (4) feet by six (6) feet or less shall be of one (1) sheet.

(2) **Extruded Aluminum Panels.** Extruded sections for destination and guide signs shall be of the bolted type conforming to ASTM B 221, alloy 6063-T6 (Chemical composition only).

Panels shall be flat and straight within the tolerances shown ASTM B 221. The Contractor shall fasten the panels with the: *

(a) bolts conforming to ASTM B 211, alloy 2024-T4, *

(b) nuts conforming to ASTM B 211, alloy 6061-T6, and *

(c) flat washers conforming to ASTM B 209, alloy Alclad 2024-T4. *

Structural shapes for sign brackets shall conform to ASTM B 308, alloy 6061-T6.

Twelve (12) inch wide sections shall weigh between 2.690 to 2.707 pounds per linear foot. Six (6) inch wide sections shall weigh between 1.103 to 1.115 pounds per linear foot. The Contractor shall use six (6) inch wide sections at tops or bottoms of signs to fill in for signs not conforming to one-foot modulus. *

(3) **Laminated Panels.** Laminated panel sections for destination and guide signs include two (2) aluminum sheets: *|

(a) laminated to a phenolic impregnated cellulose honeycomb core; *|

(b) with an extruded aluminum perimeter frame; and *|

(c) to produce flat, rigid panels one (1) inch or two and a half (2-1/2) inches thick as required. *|

The panels shall be smaller than twenty-four (24) feet long by five (5) feet wide. If specified, the Contractor may make up signs over fifteen (15) feet long up in vertical panels. The minimum width of panel shall be two (2) feet. *|

The Contractor shall make graduations in six (6) inch increments in both width and length. The Contractor shall establish vertical height of panels by the copy layout to appear on the face of the sign. The maximum span between supports on one (1) inch panels shall not exceed nine (9) feet and the overhangs shall not exceed three (3) feet. The maximum span for two and a half (2-1/2) inch panels shall not exceed fourteen (14) feet six (6) inches and the overhangs shall not exceed four (4) feet nine (9) inches. *|

The Contractor shall make laminated panels according to the following: *|

(a) The Contractor shall make the panel face sheet in one (1) piece per panel from 0.063 inch aluminum porcelain enameling sheet of 6061 or 6111 alloy, ASTM B 209. *|

(b) Core material shall be phenolic impregnated cellulose honeycomb equal to AMS-3720 standards. The core material shall be one (1) inch or two and a half (2-1/2) inches thick according to the contract. The thickness of core material shall be within a tolerance of + 0.010 inch. Core material for resistance to fungus shall meet Federal Specifications MIL-D-5272C. *|

(c) The Contractor shall assemble the back sheet from the 0.040-inch sheet aluminum alloy 3003-H14, ASTM B 209 in one (1) piece. The Contractor shall treat the surface with an amorphous chromate conversion coating conforming to Federal Specifications MIL-C-5541B. *|

(d) The laminating adhesive shall be of the thermoplastic neoprene rubber bases solvent type. The laminating adhesive shall exhibit a resilient oil and water resistant bond. The solids content shall be suitable for automatic spray application. The solids content shall also yield a dry weight *|

of adhesive of 4.5 grams per square foot minimum. The Contractor shall apply a uniform film (scotch grain appearance) of adhesive to each surface by the automatic spray application. The Contractor shall force dry them at a minimum temperature of one hundred eighty (180) degrees Fahrenheit. The Contractor shall make the final bond while the glue line temperature is at a minimum temperature of one hundred eighty (180) degrees Fahrenheit. The Contractor shall use sufficient pressure to insure intimate mating of the surfaces. The tensile strength of the Type 1 or 6061 aluminum sheets and honeycomb type laminate construction shall be thirty-five (35) to thirty-eight (38) pounds per square inch. The Contractor shall do the tensile test on a Dillon Dynamometer at room temperature with a two (2) inch by two (2) inch square section as a test specimen. The bond obtained after forty-eight (48) hour aging period shall withstand six (6) complete cycles of the Forest Products Laboratory Weathering Test, ASTM D 1037.

(e) On the face and back of every panel, the Contractor shall use a one-eighth (1/8) inch self-plugging rivet to secure the sheets at each corner of the perimeter frame. Rivets for mounting of letters shall be according to the contract.

(f) All units shall be flat within a measured \pm 0.040-inch per foot across the plane of each panel from opposite corners. The Contractor shall route the perimeter edges flush and smooth. Edges shall be straight within a tolerance of \pm one-sixteenth (1/16) inch.

(g) For panel alignment extrusion, the Contractor shall provide the closure and alignment aluminum extrusions between panels for multiple panel signs. The extrusion shall be 0.062-inch thick. The extrusion shall be of a size that shall fit snugly into the perimeter channel.

If field-joining of panels is necessary and a letter overlaps this joint, the Contractor shall pre-drill the holes in the panel to ease the letter. The Contractor shall ship the letter with the necessary rivets required for field installation.

(h) The perimeter frame around one (1) inch thick panel units shall be one (1) inch by one (1) inch by one-sixteenth (1/16) inch. The perimeter frame shall be ASTM B 221, alloy 6063-T6 extruded aluminum channel, heliarc. The Contractor shall weld the corners to prevent moisture penetration and in locations where the Contractor requires attachment of panels for support.

(i) The perimeter frame around two and a half (2-1/2) inch thick panel units shall be one (1) inch by two and a half (2-1/2) inch by 0.080 inch. The perimeter frame shall be ASTM