SECTION 712 - MISCELLANEOUS

712.01 Water. Water shall conform to AASHTO M 157, Section 4.1.4 for mixing and curing concrete, mortar and grout. Potable water requires no testing.

Recycled water from mixer wash may be used for mixing concrete if recycling is achieved by dilution. Under this process, extensive dilution and continuous agitation keep solids in a state of suspension. Water reclaimed in this manner shall not contain coloring agents or more than 300 parts per million of alkalis (Na_2O plus $0.658K_20$) as determined by filtration. Specific gravity of recycled wash water shall not exceed 1.03 plus or minus 0.01. Use of recycled water shall be discontinued if there is undesirable reaction with admixtures or aggregates.

Water that has been reclaimed by concentration will not be allowed for use.

Potable water from a local government water supply will be accepted without testing. Contractor shall test water from non-governmental water supply sources to meet criteria of AASHTO M 157 unless Engineer waives test requirements. If requested, Contractor shall submit evidence based on tests made by an independent certified laboratory that water meets the requirements of this subsection.

712.02 Epoxy-Resin Adhesive. Epoxy-resin adhesive shall conform to AASHTO M 235.

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 ready-to-use grout mix for support of structural members. Grout shall provide the required quantity of fill material without gap or void, and shall flow freely during pumping. Admixtures shall be non-metallic and shall not cause grout to rust or corrode.

Grout shall have portland cement base, expansive agent, carefully graded silica sand, and shall be packaged in 50-pound multi-wall bags with polyethylene liners.

Grout characteristics shall conform to Table 712.04-1 – Grout Characteristics.

TABLE 712.04-1 – GROUT CHARACTERISTICS	
DESCRIPTION	**REQUIREMENT**
Yield	0.8 Cubic Foot per 100 pounds
Initial Set	Approximately One Hour at 68 to 72 degrees F
Final Set	Approximately Five Hours
Work Time	50 to 60 Minutes

Compressive strength shall conform to Table 712.04-2 – Compressive Strength Requirements.

TABLE 712.04-2 – COMPRESSIVE STRENGTH REQUIREMENTS		
Age (Days)	**Compressive Strength (psi)**	**Expansion (percent)**
1	1,700	---
3	4,300	---
7	6,000	---
28	8,900	0.0002

Testing for compressive strength shall conform to ASTM C 109/C 109M.

Grout shall be mixed only by addition of water in accordance with Section 712.01 - Water. Grout shall be used in mixed form only and shall not be dry packed.

For slump of 4 inches, grout shall be mixed at rate of 1/2 to 3/4 gallon of water per 50-pound bag of cement. Water content of grout shall be adjusted to suit field conditions.

(B) Epoxy Grout. Epoxy grout shall be two-component, 100 percent solid, moisture-insensitive, epoxy-resin system intended for use as high strength grout for anchor bolts when mixed with aggregate. Epoxy grout shall meet the requirements listed in Table 712.04-3 – Properties of Neat Material.

TABLE 712.04-3 - PROPERTIES OF NEAT MATERIAL

DESCRIPTION	REQUIREMENT
Tensile Strength (ASTM D 638)	3,500 psi min. at 14 Days, 73 Degrees F Cure
Tensile Elongation (ASTM D 638, Modified)	1/2 to 2 percent at 14 Days, 73 degrees F Cure
Compressive Strength (ASTM D 695)	12,500 psi min. at 28 Days, 73 degrees F Cure
Compressive Modulus (ASTM D 695)	470,000 psi min. at 28 days, 73 degrees F Cure
Compressive Strength (ASTM D 695)	5,500 psi min. at 24 hours, 73 degrees F Cure
Water Pickup (ASTM D 570)	1.5 percent maximum

Before using epoxy grout on the project, Contractor shall submit to Engineer for acceptance a certificate of compliance from manufacturer or supplier affirming that proposed material conforms to requirements of this subsection and ASTM C 881, Type IV, Grade 2, Class C. Low viscosity epoxy grout for deep vertical dowel application will be allowed.

712.05 Precast Concrete Curb, Gutter. Precast concrete curb, gutter, and curb and gutter shall be portland cement concrete constructed to lengths, shapes, and details shown in the contract documents. Steel reinforcement shall conform to Subsection 709.01 - Reinforcing Steel.

Precast concrete curb, gutter, and curb and gutter shall be cast with wood or metal forms. Exposed surfaces and back face of curb extending to depth of two inches from top shall be constructed using forms that will produce smooth finish.

Precast concrete curb, gutter, and curb and gutter shall remain in forms at least 24 hours after casting. Cure concrete for three days.

Precast concrete curb, gutter, and curb and gutter may be placed in position after seven days.

712.06 Precast Concrete Unit.

(A) Precast Reinforced Concrete Manhole Section. Precast reinforced concrete manhole riser and top shall conform to ASTM C 478.

(B) Concrete Pull Box. Pull box shall be precast reinforced concrete. Portland cement concrete shall be Class B in accordance with Section 601 - Structural Concrete. Reinforcing steel shall conform to Section 602 - Reinforcing Steel.

712.07 Frames, Grates, Covers, and Ladder Rungs.

(A) Frame and Cover. Frame and cover for manhole or handhole shall be cast iron conforming to ASTM A 48/A 48M, Class No. 30.

Castings shall be fabricated accurately to dimensions shown in contract documents and machined if necessary for flat and true surface.

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

Bearing surface of unit shall be constructed so that cover lies flat on frame with snug fit in normal position.

Castings shall be cleaned thoroughly and painted on all sides before leaving shop with one coat of high-grade asphalt conforming to ASTM A 849, Class M, Fully Coated.

(B) Frame and Grate. Frame and grate shall be cast iron conforming to ASTM A 48/A 48M, Class No. 30, unless steel is specified in the contract documents.

Steel frame and grate shall conform to ASTM A 283/A 283 M, Grade D; ASTM A 27/A 27M, Grade 65-35; or ASTM A 47/A 47 M, Grade 35018. Zinc coating shall be provided according to ASTM A 123/A 123M.

Reinforcing steel for grate shall conform to Subsection 709.01 - Reinforcing Steel. Frame and grate shall be cleaned thoroughly and painted with one coat of high-grade asphalt conforming to ASTM A 849, Class M, Fully Coated, at shop. Second coat of paint shall be applied after installation.

Fabricated frame and grate shall be true to line and free of twists, bends, and open joints. Splices will not be allowed. Cut surfaces and edges shall be smoothed by machining or grinding before fabrication of frame and grate.

Size and length of weld shall be as specified in contract documents.

(C) Ladder Rungs.

(1) Water Valve Manhole. Ladder rungs for water valve manhole shall be 3/4-inch diameter, hot-dipped, zinc-coated carbon steel conforming to ASTM A 36/A 36M; or stainless steel, Type 302, 304, or 315. Rungs shall be fabricated in accordance with contract documents.

(2) Sanitary Sewer Manhole. Ladder rungs for sanitary sewer manhole shall be fabricated in accordance with contract documents. Top rung shall be 1-inch diameter wrought iron bar conforming to ASTM A 36 and shall be zinc coated by hot dipping after fabrication; or 3/4-inch diameter stainless steel bar, Type 302, 304, or 315.

Rungs other than top rung shall be cast iron conforming to ASTM A 48/A 48 M or ductile iron conforming to ASTM A 439. Rungs shall be cleaned thoroughly and painted with two coats of bitumastic or hot asphalt.

(3) Storm Drain Manhole. Ladder rungs for storm drain manhole shall be 1-inch diameter wrought iron or stainless steel bar, or 1/2-inch diameter steel-reinforced, copolymer polypropylene plastic bar.

Wrought iron rung shall conform to ASTM A 36/A 36 M, and shall be zinc coated by hot dipping after fabrication.

Stainless steel rung shall be Type 302, 304, or 315.

Steel-reinforced, copolymer polypropylene plastic bar shall conform to the requirements of ASTM C 478/C 478 M and ASTM C 497/C 497 M, except that minimum horizontal pullout load shall be 1,500 pounds; ASTM A 615/A 615M, Grade 60 (deformed reinforcing steel bar); ASTM D 4101; and AASHTO M 199. Steps shall have foot-safe end lugs permanently molded into the step, and safety foot thread designed for positive grip. Contractor shall provide Certificate of Compliance prepared by independent certified laboratory affirming that plastic bar conforms to requirements of this subsection. Certificate shall be submitted concurrently with request for Engineer's acceptance.

(D) Eye Bolts, Nuts, and Washers for Type A Water Manhole. Eyebolts for Type A water manhole shall be 1-inch diameter, 6 inches long, zinc-coated, with 1-inch eye. Washers shall be steel plate, 1/4 inch by 6 inches by 6 inches. Nuts shall be American Standard heavy cold-punched hexagon, and shall be zinc-coated.

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) Preformed Fabric Pad.

(1) Pad Under Railing Post. Preformed fabric pad shall consist of multiple layers of 8-ounce cotton duck impregnated and bound with high-quality natural rubber, or material acceptable by Engineer that has been compressed into resilient pads of uniform thickness.

Number of plies shall be as required to provide thickness as specified in contract documents, after compression and vulcanization. Finished pads shall withstand compression loads of at least 10,000 pounds per square inch applied perpendicular to the plane of laminations without detrimental reduction in pad thickness or extrusion.

(2) Pad For Bridge Bearing. Preformed fabric pad shall consist of multiple layers of cotton duck impregnated and bound with rubber, compressed into resilient pads of uniform thickness, conforming to Federal Specification MIL-D-882D. Number of plies shall be as required to provide thickness specified in contract documents, after compression and vulcanization. Finished pads shall withstand compression loads of at least 10,000 pounds per square inch applied perpendicular to the plane of the laminations without detrimental reduction in pad thickness or extrusion.

(C) Elastomeric Bearing Pad. Elastomeric bearing pad 1/2 inch and less in thickness shall not be laminated. Pad thicker than 1/2 inch shall be laminated.

Laminated pad shall comprise bonded alternating layers of elastomer and metal, or elastomer and fabric. Top and bottom layers of reinforcement and all edges of bearing pad shall be covered with minimum 1/8-inch thick elastomer.

Laminated pad shall be reinforced for every 1/2 inch of pad thickness. Fabric reinforcement shall be single ply for outside layers of pad and double ply for inside layers. Reinforcement shall be parallel to top and bottom surfaces of pad. Position of any reinforcement layer within pad shall not deviate more than 1/8 inch from correct position. Steel laminated pad shall conform to ASTM D 4014.

Total thickness of pad shall not be less than that specified in contract, documents and not greater than 1/4 inch above specified thickness. Thickness of individual layer shall not exceed specified thickness by more than 1/8 inch. Length and width of pad shall not vary more than 1/8 inch from dimensions specified in the contract documents.

Cutting of bearing pad laminated with elastomer and fabric will be allowed. Large sheets shall be cut in manner that will not require heating, produces smooth edge with no tears or jagged sections, and causes minimum damage to material.

Rounding of corners and edges of molded pads is allowed. Radius of corners shall be 3/8 inch maximum. Radius of edges shall be 1/8 inch maximum.

Minimum peel strength of bond between elastomer and metal or elastomer and fabric shall be 30 pounds per inch when laminate is tested for separation according to ASTM D 429 Method B.

Fabric reinforcement shall be woven from 100 percent glass fibers of "E" type yarn with continuous fibers. Minimum thread count in either direction shall be 25 threads per inch. Fabric shall have crowfoot or 8 Harness Satin weave. Fabric reinforcement shall be single ply at top and bottom layers of pad and double ply for middle layers. Each ply shall have breaking strength of at least 800 pounds per inch of width in each thread direction. Bond between double plies shall have minimum peel strength of 20 pounds per inch. Samples 3 inches by 36 inches in size shall be tested on split drum grips.

Rubber component of elastomeric laminations shall be at least 60 percent neoprene by volume.

Elastomer of samples and test specimens shall be tested for conformance to Table 712.09-1 – Elastomer Requirements Original Physical Properties.

TABLE 712.09-1 – ELASTOMER REQUIREMENTS		
ORIGINAL PHYSICAL PROPERTIES		
TEST	**ASTM Designation**	**Requirement**
Tensile strength, psi	D 412	2,500 min.
Elongation at break, percent	D 412	350 min.
Compression set, 22 hours at 158 degrees F, percent (Method B)	D 395	25 max.
Tear strength, pounds per inch (Die C)	D 624	250 min.
Hardness (Type A)	D 2240	60 ± 5
Ozone resistance, 20 percent strain, 100 hours at 100 degrees F± 2 degrees F	D 1149*	No cracks
Low temperature stiffness, Young's Modulus at 40 degrees F, psi	D 797	10,000 max.
After accelerated aging in oven for 70 hours at 212 degrees F the elastomer shall not show deterioration changes in excess of the following:	D 573	
Tensile strength, percent		±15
Elongation at break, percent change		- 40 max.
Hardness, point		0 to ±15
*Samples shall be solvent wiped before test to remove surface impurities.		

Samples and test specimens shall show no deterioration of elastomer or bond between elastomer and metal or fabric reinforcement when tested in accordance with Hawaii Test Method HWY-TC 13 for 10,000 cycles at 800 pounds per square inch and (1/2)t (t=total thickness of elastomer) translation. Testing speed shall not exceed 4-1/2 inches per minute.

Contractor shall submit to Engineer for acceptance Certificates of Compliance from a independent certified laboratory affirming conformance of

elastomeric pads with requirements of this subsection. Certificates shall be submitted before installing elastomeric pads.

Adhesive used to secure pad to concrete shall be as recommended by manufacturer.

(D) Bronze and Stainless Steel Bearing and Expansion Plate. Bronze and stainless steel bearing and expansion plate shall be of type in standard production by established manufacturer of bearing and expansion plates.

Bronze bearing plate shall conform to ASTM B 22, Alloy B, and shall be self lubricating. Bronze bearing plate shall have trepanned recesses, and not grooves, filled with lubricating compound that will withstand atmospheric elements. Lubricating compound shall comprise graphite and metallic substances with lubricating binder. Compound shall be pressed into the recesses by hydraulic presses to form dense, non-plastic lubricating inserts. Shellac or other non-lubricating binder will not be allowed.

Lubricating area shall occupy at least 25 percent of total bearing area, have capacity of at least 2,500 pounds per square inch of bearing, and provide coefficient of friction for bronze on stainless steel no greater than 0.1 for load of 2,500 pounds per square inch. Contact surface shall be finished in direction of movement according to ANSI B 46.1, No. 125.

Masonry and sole plates shall be stainless steel conforming to ASTM A 743 and ASTM A 744. Sliding surface and contact with bronze bearing plate shall be finished in direction of movement according to ANSI B 46.1, 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 surfaces shall be aluminum oxide with grain size from No. 8 to No. 16. Coating shall be unaffected by freezing, moisture, or cleaning compounds.

712.12 Sheathing. Sheathing covering wire rope shall be high-density polyethylene with ultraviolet protection. Polyethylene shall be cell classification 334413 by ASTM D 3350. Sheathing shall be hot melt extruded over the grease coated wire cable. No other methods of applying HDPE sheathing over wire cable will be allowed. Minimum thickness of HDPE sheathing shall not be less than 0.060 inches.

712.13 Corrosion-Inhibiting Grease. Corrosion-inhibiting grease shall provide corrosion protection to wire cable, provide a continuous, non-brittle film at the lowest anticipated temperature, 50 degrees F of exposure, and shall be chemically stable and non-reactive with wire cable.

Grease shall be an organic coating with appropriate polar, moisture-displacing and corrosion-preventive additives. Provide test results in accordance with performance specifications for corrosion-inhibiting grease.

Table 712.13-1 - PERFORMANCE SPECIFICATIONS FOR CORROSION-INHIBITING GREASE

Test	Test method	Acceptance criteria
1. Dropping point	ASTM D-566 or ASTM D-2265	Minimum 300 degree F
2. Oil separation at 160 degree F, percent by weight	FTMS 791B METHOD 321.2	Maximum 0.5
3. Water, percent maximum	ASTM D-95	0.1
4. Flash point (refers to oil component)	ASTM D-92	Minimum 300 degree F
5. Corrosion test 5 percent salt fog at 100 degree F, 5 mils, minimum hours (Q panel type S)	ASTM B-117	Rust grade 7 or better after 1000 hours of exposure according to ASTM D-610
6. Water soluble ions (1)		
A. Chlorides, PPM maximum	ASTM D-512	10
B. Nitrates, PPM maximum	ASTM D-992	10
C. Sulfides, PPM maximum	APHA 427D (15th Ed.)	10
7. Soak test 5 percent salt fog at 100 degree F 5 mils coating, Q panels, Type S, Immerse panels 50 percent in a 5 percent salt solution and expose to salt fog	ASTM B-117 (Modified)	No emulsion of the coating after 720 hours of exposure.

Table 712.13-1 - PERFORMANCE SPECIFICATIONS FOR CORROSION-INHIBITING GREASE (Continued)		
8. Compatibility with sheathing		
A. Hardness and volume change of polymer after exposure to grease, 40 days at 150 degree F	ASTM D-4289	Permissible change in Hardness 15 percent. Permissible change in volume 10 percent.
B. Tensile strength change of polymer after exposure to grease, 40 days at 150 degree F	ASTM D-638	Permissible change in tensile 30 percent

712.14 (Unassigned)

712.15 (Unassigned)

712.16 (Unassigned)

712.17 (Unassigned)

712.18 (Unassigned)

712.19 (Unassigned)

712.20 (Unassigned)

712.21 (Unassigned)

712.22 Pipe Collar for Valve Box. Iron pipe collar or sleeve for valve boxes shall be ductile iron pipe conforming to AWWA C151. Diameter and length shall be specified in contract documents.

712.23 Precast Concrete Meter and Valve Boxes and Covers. Types A, B, and X Meter and Valve Boxes and Covers shall be constructed as specified in contract documents.

Portland cement concrete shall have compressive strength of at least 2,500 pounds per square inch, and shall conform to Section 601 - Structural Concrete.

Maximum concrete density in finished product shall be 115 pounds per cubic foot and its maximum absorption shall be 15 pounds per cubic foot.

712.24 Valves and Appurtenances.

(A) Gate Valves.

(1) General. Valves shall have non-rising stems with inside screw and shall open to left or counterclockwise. Valves shall have manufacturer's name, size, catalog number, and working pressure molded or stamped thereon in places where name and number may be easily seen when valves are installed. External surfaces of valves shall be shop coated with fusion-bonded epoxy coating or with two coats of an asphalt coating conforming to Federal Specifications TT-C-494B. Valves shall be furnished complete with all accessories.

Push-on joint, mechanical joint, and flanged joint for gate valves shall conform to applicable requirements specified for joints.

For island of Maui only, mainline valves shall be mechanical joint or flange joint gate valves shall be used for buried service.

All valves shall be for buried service unless otherwise specified.

Stuffing box bolts and nuts, bonnet bolts and nuts, and gland or flange bolts and nuts shall be Silicon Bronze in accordance with ASTM F467 and F468 or may be ASTM F593 and F594, Type 316 stainless steel bolts and nuts. All stainless steel bolt and nut threads shall be pre-coated with anti-seizing graphite compound before installation.

All valves shall be full body and not thin-walled or reduced walled-type.

For working pressures of 200 psi or less, all gate valves 4-inches to 12-inches (16-inch for Maui) shall be resilient seat type of gate valve. For working pressures greater than 200 psi or when gate valve size is larger than 12-inches (16-inch for Maui), gate valve shall be metal-seated type.

(2) 3-Inch and Smaller Valves. Valves shall be wedge-disc type with non-rising stem, screw ends, and brass or bronze body. Metal composition of body, centerpiece, and other cast parts shall be bronze, meeting requirements of ASTM B62. All packing shall be Johns-Manville "Duro" packing style No. S-171 and shall have each ring cut to fit with staggered joints. Continuous (spiraled) packing shall not be used. Valves shall be provided with brass handwheels

and stuffing glands. Unless otherwise specified, valves shall be for 200-pound water service.

(3) Metal-Seated Valves 4-Inch and Larger. All metal-seated gate valves 4-inch and larger shall conform to AWWA C500 with cast iron body, bronze (not brass) mounted, double disc, and parallel seat and shall be furnished with 2-inch square operating nuts. Valves shall be equipped with double O-ring stem seals with both rings located above collar. Valves shall have either push-on, mechanical joint or flanged joint ends as designated in contract documents.

Sixteen-inch and larger valves shall be provided with cast steel cut tooth, bevel gears with integral or extended gear case, lubricated and supplied with watertight gland enclosure. Valves shall be equipped with by-pass as shown in Table 712.24-1 – By-Pass Valves (For island of Maui only, gate valve shall be fusion bonded epoxy coated.)

TABLE 712.24-1 – BY-PASS VALVES

Size of Valve (Inches)	Size of By-Pass Valve (Inches)
16-20 Inclusive	3
24-30 Inclusive	4
36-42 Inclusive	6

By-pass shall be in horizontal plane when gate valves are installed in line.

All valves except bevel geared gate valves shall operate "upright" (vertical in horizontal pipe.) Bevel geared gate valves shall operate on "edge" (horizontal in horizontal pipe) and shall be equipped with solid bronze rollers, tracks, and scrapers.

Valves shall be either Class 150, Class 200, or Class 250 as designated in contract documents. Class 250 valves shall be designed for 250 pounds working pressure and tested to 400 pounds.

All bolts and nuts shall be either silicon bronze (ASTM F467 and F468) or stainless steel (ASTM F593 and F594, Type 316). All bolts and nuts shall be silicon bronze only if submerged in water. Bolts and nuts installed shall be compatible in strength and material characteristics. Bolts shall protrude beyond nuts and protrusion shall

be a minimum of 1/8-inch but shall not exceed 1/2-inch. All stainless steel bolt and nut threads shall be pre-coated with anti-seizing graphite compound before installation. Dimensions of bolting material shall meet ANSI B18.2.1 specifications. Bolting of valve body parts shall be by bolts and nuts. Tapped bolt holes into valve body will not be allowed.

(4) Resilient-Seated Gate Valves. Resilient-seated gate valves shall be manufactured to meet all applicable requirements of AWWA C509. "Resilient-Seated Gate Valves For Water And Sewerage Systems". Valves shall be either 4, 6, 8, or 12-inch in size and rated for service at 200 psi working pressure. Valves shall have non-rising stems, opening by turning left and provided with 2-inch square nut with arrow cast in metal to indicate direction of opening. Each valve shall have manufacturer's name, pressure rating and year in which manufactured cast on body.

All bolts and nuts shall be either silicon bronze (ASTM F467 and F468) or stainless steel (ASTM F593 and F594, Type 316). All bolts and nuts shall be silicon bronze only if submerged in water. Bolts and nuts installed shall be compatible in strength and material characteristics. Bolts shall protrude beyond the nuts and protrusion shall be a minimum of 1/8-inch but shall not exceed 1/2-inch. All stainless steel bolt and nut threads shall be pre-coated with anti-seizing graphite compound before installation. Dimensions of bolting material shall meet ANSI B18.2.1 specifications. Bolting of valve body parts shall be by bolts and nuts. Tapped bolt holes into valve body will not be allowed.

Stuffing boxes shall be of an O-ring design with a minimum of three O-rings. No gasket material made of asbestos shall be used.

Interior and exterior coating shall be fusion epoxy meeting AWWA C550, "Standard For Protective Interior Coatings For Valves and Hydrants".

Stem shall be bronze meeting requirements of Grade D or Grade E Bronze as specified in AWWA C509.

Low friction torque reduction thrust bearings shall be located both above and below stem collar.

If guides for gate are required, there shall be no metal-to-metal contact, only metal-to-rubber.

(B) Butterfly Valves and Manual Operators.

(1) General. Manufacturer of rubber-seated butterfly valve and manual operator shall be nationally advertised firm with at least ten years' experience in design and manufacture of valves of this type.

(2) Butterfly Valves. Butterfly valves shall conform in all respects with AWWA C504, Class 150B. Valve shall be short body valve with cast iron body. Valve disc shall be cast or ductile iron, unless otherwise specified. If rubber seat is mounted on valve body, the valve disc shall be made of Ni-Resist unless a stainless steel seat ring is furnished. Valves shall have either push-on joint, mechanical joint, or flanged joint ends as designated in contract documents. External surfaces of valves shall be shop coated with fusion-bonded epoxy coating or with two coats of an asphalt coating conforming to Federal Specifications TT-C-494B. Interior surfaces of butterfly valves shall be fusion bonded epoxy-coated.

All bolts and nuts shall be either silicon bronze (ASTM F467 and F468) or stainless steel (ASTM F593 and F594, Type 316). All bolts and nuts shall be silicon bronze only if submerged in water. Bolts and nuts installed shall be compatible in strength and material characteristics. Bolts shall protrude beyond the nuts and protrusion shall be a minimum of 1/8-inch but shall not exceed 1/2-inch. All stainless steel bolt and nut threads shall be pre-coated with anti-seizing graphite compound before installation. Dimensions of bolting material shall meet ANSI B18.2.1 specifications. Bolting of valve body parts shall be by bolts and nuts. Tapped bolt holes into valve body will not be allowed.

(3) Manual Actuator. Manual actuator shall conform in all respects with AWWA C504 unless otherwise stated in these specifications. Manual operator shall be furnished with a 2-inch square operating nut, and a valve position pointer.

(4) Manufacturer's Identification. Manufacturer's name and catalog number shall be molded or stamped on valve where it can be easily seen after valve is installed.

(5) Submittals for Approval. Following submittals shall be furnished to Engineer for approval by County Water Supply System for each project before valve is installed:

(a) Certification from valve manufacturer that both valve and actuator conform to all requirements of AWWA C504.

(b) Certified drawings of valve and operator as specified in AWWA C504.

(c) Certified copies of reports of torque rating of manual operator as specified in AWWA C504.

(d) Calculations showing required operator input torque to develop operating torque specified for Class150B, of AWWA C504.

(C) Tapping Valves and Sleeves. Tapping valves and sleeves shall fit A.P. Smith and Mueller tapping machine. All tapping valves and sleeves shall be furnished complete with bolts, nuts, and other standard accessories.

Valve ends to accommodate tapping machines shall be mechanical or flange joint for taps up to 24-inches in diameter. For taps larger that 24-inch mains, the materials, tools and equipment shall be provided to Engineer by Contractor and shall be verified with pipe manufacturer prior to approval by County Water Supply System. (For Hawaii and Kauai only, the nominal tap size shall be smaller that nominal main size.) (For Oahu only, the nominal tap size shall be smaller that nominal main size for concrete cylinder pipe only.)

Ends of sleeves shall be mechanical joint to fit Class 52 cast iron pipe, Class 150 or 200 PVC C-900 pipe, or Class 150 PVC C-905 pipe. Sleeves shall have flanged end outlets for valve connections. External surfaces of valves shall be shop coated with fusion-bonded epoxy coating or with two coats of an asphalt coating conforming to Federal Specifications TT-C-494B.

Tapping sleeves for use with concrete cylinder pipe shall be modified according to drawings shown in Section 403 - Standard Details of the Water System Standards dated 2002. Contractor shall submit shop drawings to Engineer for approval by County Water Supply Systems prior to installation.

All bolts and nuts shall be either silicon bronze (ASTM F467 and F468) or stainless steel (ASTM F593 and F594, Type 316). All bolts and nuts shall be silicon bronze only if submerged in water. Bolts and nuts installed shall be compatible in strength and material characteristics. Bolts shall protrude beyond the nuts and protrusion shall be a minimum of 1/8-inch but shall not exceed ½-inch. All stainless steel bolt and nut threads shall be pre-coated with anti-seizing graphite compound before installation. Dimensions of bolting material shall meet ANSI B18.2.1 specifications. Bolting of valve body parts shall be by bolts and nuts. Tapped bolt holes into valve body will not be allowed.

For Maui only, use of stainless steel tapping sleeves will not be allowed.

(D) Ball Valves and Appurtenances. Ball valves shall have full port opening and have female threaded ends, unless other wise noted in the contract documents, meeting dimensions stated in AWWA C800. Valves shall be rated for a minimum of 200 pound water service. Valves shall be between 3/4-inch to 2-1/2-inch in size. Valve body shall be made of bronze conforming to ASTM B62. Ball shall be made of bronze, ASTM B62 and be Teflon-plated or chrome-plated. All seals, thrust wasters, and packing rings shall be made of Teflon or Buna-N.

Handwheels shall be provided and made of bronze, ASTM B62. Handwheel shall be removable when valve is in service and under pressure. Lever handles may be substituted for handwheels. Lever handles shall be made of bronze, ASTM B 62 and sturdily bolted to ball valve with bronze ASTM B62 bolting material; or Type 316 stainless steel, ASTM A193, ASTM A194, ASTM F593, and/or ASTM F594, bolting material.

Ball valves between 3/4-inch to 1-1/4 inch in size, handwheels shall have a maximum radius of 1-1/2 inch from vertical center of valve. Lever handles shall have a maximum width of 1-inch and a radial length between 2-1/2-inch to 3-inch from vertical center of valve to end of handle.

Ball valves between 1-1/2-inch to 2-1/2-inch in size, handwheels shall have a maximum radius of 3-inch from vertical center of valve. Lever handles shall have a maximum width of 1-inch and a radial length between 3-inch to 4-inch from vertical center of valve to end of handle.

All ball valves shall have locking capability and shall be blowoff-proofed to atmosphere.

(E) Air Relief Valves/Combination Air Valves and Appurtenances. Air Relief Valves/Combination Air Valves and Appurtenances (ARV) shall conform to AWWA C512, “Standard For Air-Release, Air/Vacuum, and Combination Air Valves For Water Services”. ARV shall be configured for underground installation with a threaded body inlet and treaded cover outlet. Air relief valve bodies and covers shall be of gray cast iron conforming to ASTM A126, Class B or ASTM A48, Class 35 or ductile iron conforming to ASTM A536, Grade 65-45-12. ARV inlet size and rated maximum working pressure shall be as called for in contract documents.

Valve and valve seat shall be of bronze, conforming to ASTM B62, Type 316 stainless steel, or Buna-n-rubber. However, no stainless steel to stainless steel or Buna-n-rubber to Buna-n-rubber will be allowed.

Valve trim, including levers, float arms, pins, and vent cocks shall be bronze conforming to ASTM B 62 or type 316 stainless steel.

Floats shall be of highest quality seamless copper or stainless steel and shall operate with adequate force to insure positive valve action.

External surfaces of ARVs shall be shop coated with fusion-bonded epoxy coating or with two coats of an asphalt coating conforming to Federal Specifications TT-C-494B.

Fittings and nipples for connections of air relief valves shall be cast bronze or “Standard” brass (Grade A) screwed joint with metal conforming to Section 211 – Brass Products of Water Systems Standards dated 2002.

Vertical check valve shall be designed to operate on upward flow only and shall be brass or bronze. Valves shall be for 200-pound working pressure unless otherwise specified.

Ball corps and ball stops shall be as specified in Section 208 - Service Laterals and Appurtenances in Water Systems Standards dated 2002.

Orifice size for ARV shall be as shown in Table 712.24-2 - ARV.

Table 712.24-2 - ARV

ARV Inlet Size	Maximum Working Pressure (PSI)	5 percent Air Content (Standard Cubic Feet Per Minute)	Corresponding Orifice Size
3/4-inch	150	25	1/8-inch
3/4-inch	250	25	7/64-inch
1-inch	150	32	5/32-inch
1-inch	250	32	1/8-inch
2-inch	150	88	1/4-inch
2-inch	250	88	7/32-inch

Corporation stop shall conform to Subsection 707.11 - Copper Service Pipe and Appurtenances.

(F) Valve Markers. Valve markers shall be as shown in Section 403 – Standard Details of the Water System Standards dated 2002. Concrete for footings shall be as specified in Section 601 – Structural Concrete.

712.25 Pipe Hangers, Lateral Bracings, and Inserts. Pipe hangers and lateral bracings shall be made of carbon steel, galvanized and shall be fabricated to dimensions specified in contract documents. Pipe hangers shall be furnished complete with hanger rods, inserts, lateral bracings, bolts and nuts. Pipe hangers shall be capable of vertical adjustments.

Pipe hanger inserts shall be bronze conforming to ASTM B 22, Class "D" Grade, or gray iron castings conforming with ASTM A 48, Class 30. Inserts shall be made in accordance with dimensions and notes shown in contract documents.

712.26 Hydrants and Appurtenances.

(A) General. Hydrants shall be manufactured in accordance with requirements of AWWA C502 or C503.

All hydrants shall be subjected to hydrostatic pressure test of 300 pounds per square inch, and pressure test shall be guaranteed by manufacturer. Two copies of Certification of Test shall be furnished to Engineer before delivery.

Bell end of 6-inch intake pipe (hydrant bottom elbow) shall be mechanical joint or push on joint and shall conform to all applicable requirements of ANSI A-21.11 and AWWA C111.

All hydrants parts shall be distinctly marked with its name, part number, length, size, and maker's name. Marking shall be on cloth tags securely fastened to parts with wire or shall be painted on parts by such other means as will insure positive identification of parts upon delivery.

Each hydrant body shall be furnished with a set of break-off bolts, nuts, and full face gasket. Bolts shall be break-off type drilled 11/32-inch x 1-3/8 inch. Nuts shall be stainless steel American Standard heavy cold punched, hexagon nuts. Gaskets shall be 1/8-inch cloth inserted rubber. Hydrant flange shall have six 3/4-inch bolt holes on 9.375-inch diameter.

Body design shall be approve by County Water Supply Systems.

Composition of valving shall be Balata Gum. Valve and valve carrier shall be attached to operating stem utilizing an "O" ring seal to prevent leakage through valve. Stem packing shall be of "O" ring type incorporating two "O" rings in stem sleeves.

For Oahu only, all bronze fire hydrants shall be installed with bronze caps.

Manufacturer shall make and test at least one test bar from each heat of metal used in accordance with ASTM Specifications pertaining thereto.

Hydrants shall receive minimum SSPC SP3 surface preparation and coated as follows:

(1) Primer. Mobil 13-W-10 water epoxy enamel or approved equal.

(2) Intermediate Coat. Mobil 98 Series water epoxy hi-build or approved equal 0.5 mil DFT.

(3) Finish. Mobil 91 Series water epoxy enamel 2 mil DFT (Color: OSHA Yellow).

Prepare surface between coats to proper condition for painting. Coating shall not be applied until preceding coat is hard and dry.

Fire hydrants shall be provided with bonnets, stuffing boxes and other appurtenant features all made of silicon bronze conforming to ASTM B 98 and as specified in Section 402 – Approved Material List of the Water System Standards dated 2002.

(B) Wet-Barrel Hydrants. Wet-Barrel Hydrants are not applicable for Hawaii.

All hydrants shall comply with AWWA C503 “Wet-Barrel Fire Hydrants for ordinary Water Works Service”. All hydrants shall have one 4-1/2 inch and one 2-1/2 inch outlet with Type B valves.

Body design shall be as approved by the County Water Supply System.

Hydrants shall be tested to hydrostatic pressure of 300 pounds per square inch. Two copies of certification of test shall be submitted to Engineer for acceptance by County Water Supply System before delivery.

Bell end of 6-inch intake pipe shall be mechanical joint or push-on joint and shall conform to requirements of ANSI 21.11 and AWWA C111.

Castings and finished surface shall be in accordance with the contract documents. Machined parts on hydrants shall be interchangeable and fit the County Water Supply System’s standard gages.

At least one test bar from each heat of metal used shall be tested in accordance with applicable ASTM specifications.

Hydrant body shall be cleaned by removing oil, grease, dirt, or other loose material. Hydrant shall be painted with hydrant paint acceptable to Engineer.

Hydrant parts shall be distinctly marked with its name, part number, length, size, and marker's name. Markings on cloth tags shall be securely fastened to parts with wire, or markings shall be painted on parts, or other means to ensure positive identification of parts upon delivery.

Hydrant body shall be furnished with set of break-off bolts, nuts, and full-face gasket. Nuts and bolts shall be hot-dip zinc-coated. Bolts shall be 5/8 inch by 3-inch machine bolts with hexagon heads American Standard heavy. Bolts shall be drilled 11/32 inch by 1-3/8 inch. Nuts shall be hot-dipped galvanized American Standard heavy cold punched, hexagon nuts. Gaskets shall be 1/8 inch cloth inserted rubber.

(C) Dry-Barrel Hydrants. Dry-Barrel Hydrants are for Hawaii only.

All hydrants shall comply with AWWA C502 “Dry-Barrel Fire Hydrants”. All hydrants shall have one 4-1/2 inch and two 2-1/2 inch outlets as approved by County Water Supply System.

All hydrants shall be furnished with “O” ring seal packing.

All hydrants shall be furnished with a breakable coupling device.

Barrel and operating mechanism shall be so designed that in the event of an accident, damage or breaking of hydrant above or near grade level, the main valve will remain closed and tight against leakage. Positive operating drain valve or valves shall be provided to drain hydrant properly by opening as soon as main valve is closed. Drain valve shall close when main valve is opened. Seat of drain valve shall be bronze, fastened securely in hydrant.

Body design shall be as approved by the County Water Supply System.

712.27 Conduits.

(A) Steel Conduits. Steel conduits shall be made of rigid metal conforming to ANSI Standard C80.1 and Article 344 of National Electrical Code. Exterior and interior surfaces of conduits and fittings shall be hot-dip zinc coated in accordance with AASHTO M 232. Interior of conduit shall have continuous coating of zinc-chromate, lacquer, or enamel. Each length shall bear UL label.

Six-inch conduit sample cut from center of standard length of conduit shall be submitted to Engineer for acceptance. Conduit will be tested in accordance with ASTM A 239. Interior and exterior of conduit shall not show fixed deposit of copper after four one-minute immersions in standard copper sulfate solution.

(B) Plastic Conduits. Plastic conduits shall be rigid PVC and extruded standard wall Schedule 40 or Schedule 80 electrical conduit. Each length shall bear UL label.

(C) Liquid-Tight Flexible Metal Conduit and Fittings. Liquid-tight flexible metal conduit and fittings shall conform to UL 1. Conduit and fittings shall be jacketed with PVC extrusion. Jacket shall be moisture-proof and oil-proof conforming to minimum radius bends of flexible conduit without cracking. Fittings shall be liquid-tight flexible steel conduit made of nondeteriorating, liquid-tight steel.

(D) Rigid Steel Conduit PVC Coated.

(1) Zinc-coated rigid steel conduits prior to PVC coating shall conform to Federal Specification WW-C-581d, ANSI Standard C80.1, UL Standard #6 and NEMA RN1-1980.

(2) All conduits shall be hot dip zinc-coated inside and out with zinc-coated threads.

(3) All conduit, connectors, support systems and accessories shall be PVC coated.

(4) Prior to PVC coating, zinc-coated surfaces shall be coated with epoxy-acrylic primer to ensure bond greater than coating tensile strength.

(5) 40-mil-thick, minimum, plastic coating shall be applied by dip method.

(6) Factory-applied plastic coating shall be applied by same manufacturer who produced the hot dip zinc-coated conduit. The coated conduit shall conform to NEMA Standard No. RN1-1980 (Type 40).

(7) Fittings and Accessories.

(a) Conduit clamps, u-bolts, and nuts shall be PVC encapsulated. Nuts shall be installed with manufacturer supplied wrenches.

(b) Couplings shall have 40-mil-thick longitudinal ribs.

(c) All coated conduits shall be installed in accordance with manufacturer recommendations.

(8) Interior of conduit shall be coated with 4- to 6- mil-thick phenolic coating, fusion bonded.

(E) Duct Sealing Compound. Duct sealing compound shall conform to the following:

(1) Waterproof, rodent proof, nonoxidizing; noncorrosive to metals, rubber, plastic, lacquer, and paints; and non-hardening when subject to temperatures ranging from -30 degrees F to 150 degrees F. Foam sealant will not be allowed.

(2) Readily workable for thumbing into openings and forming into seals around wires inside conduits and openings around conduits.

(3) Clean, nonpoisonous and noninjurious to human skin.

(4) Seals against water, dust, and air.

(5) Adheres to wood, glass, plastics, metal, rubber, and painted surfaces.

END OF SECTION 712