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SECTION 02223

TRENCHING, BACKFILLING, AND COMPACTING

PART 1 GENERAL

1.01 DESCRIPTION

This section includes materials, installation, and testing of trench excavation, backfilling, and compacting.

1.02 REFERENCE STANDARDS

The publications listed below form part of this specification to the extent referenced and are referred in the text by the basic designation only. Reference shall be made to the latest edition of said standards unless otherwise called for.

ASTM D1556	Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D2922	Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D3017	Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D1557	Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3(2,700 kN-m/m^3))
ASTM D4253	Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table
ASTM D4254	Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
ASTM D75	Standard Practice for Sampling Aggregates
ASTM C90	Standard Specification for Load bearing Concrete Masonry Units
ASTM A82	Standard Specification for Steel Wire, Plain, for Concrete Reinforcement

1.03 RELATED WORK SPECIFIED ELSEWHERE

FPUD Standard Drawings
FPUD General Conditions, Section 01

1.04 EARTHWORK AND REPAIRS IN CITY, COUNTY, AND STATE RIGHTS OF WAY

Conform to the requirements and provisions of the permits issued by those agencies in addition to the requirements of these Standard Specifications. If a permit is not required, earthwork and repairs shall conform to the standards of the agency in whose right of way the work is done in addition to the requirements of these Standard Specifications.

1.05 SAFETY PRECAUTIONS

Observe safety precautions in all phases of the work. Included shall be trench shoring, bracing, lighting, and barricades as dictated by reason and by the Safety Orders of the Division of Industrial Safety, State of California (CAL OSHA). Acquire an exemption letter or trenching permit from the California Division of Industrial Safety (CAL OSHA) and comply with Labor Code Section 6705, Excavation Plans For Worker Protection. Submit a copy of the exemption letter or trenching permit with excavation drawings to the District prior to excavation work.

1.06 OBSTRUCTIONS

The Contractor's attention is directed to the possible existence of pipe and other underground improvements which may or may not be shown on the Drawings. Preserve and protect any such improvements whether shown on the Drawings or not. Expose such improvements in advance of the pipeline construction to allow for changes in the alignment as necessary. Where it is necessary to remove and replace or to relocate such improvements in order to prosecute the work, they shall be removed, maintained, and, permanently replaced by the Contractor at his expense. Relocation of said improvements shall not be performed without written permission of the owner of the utility. Existing underground utilities shall be protected in place.

1.07 SUBMITTALS

A. Submit shop drawings in accordance with Standard Specification Section 1 General Conditions 2.11 Submittals.

B. Submit a report from a testing laboratory verifying that imported material is asbestos-free and conforms to the specified gradations or characteristics.

C. Cal OSHA trenching permit or exemption letter.

1.08 TESTING FOR COMPACTION

A. The District or the agency having jurisdiction over the area of the work will require the Contractor to provide a licensed soils engineer to test for compaction as described below.

B. Determine the density of soil in place by the sand cone method, ASTM D 1556 or by nuclear methods, ASTM D 2922 and D 3017.

C. Determine laboratory moisture-density relations of soils by ASTM D 1557.

D. Determine the relative density of cohesion-less soils by ASTM D 4253 and D 4254.

E. Sample backfill materials by ASTM D 75.

F. "Relative compaction" is the ratio, expressed as a percentage, of the in place dry density to the laboratory maximum dry density.

G. Make excavation for compaction tests at the locations and to the depths designated by the soils engineer. Backfill and re-compact the excavations at completion of testing. When tests indicate that the compaction is less than the specified relative compaction, rework and retest those areas until the specified relative compaction has been obtained.

1.09 PIPE BEDDING

The pipe bedding shall be defined as a layer of material immediately below the bottom of the pipe and extending over the full trench width in which the pipe is bedded. Thickness of pipe bedding shall be a minimum of 6-inches compacted to 90% relative compaction.

1.10 PIPE ZONE

The pipe zone shall include the full width of trench from the bottom of the pipe to a horizontal level 12-inches above the top of the pipe. Where multiple pipes are placed in the same trench, the pipe zone shall extend from the bottom of the lowest pipe to a horizontal level above the top of the highest or topmost pipe. Thickness of pipe zone above the highest top of pipe shall be a minimum of 12-inches.

1.11 TRENCH ZONE

The trench zone includes the portion of the trench from the top of the pipe zone to the bottom of the pavement zone or to the existing surface in unpaved areas.

1.12 UPPER ZONE

The upper zone includes the asphalt concrete and aggregate base pavement section placed over the trench backfill.

1.13 WATER FOR CONSTRUCTION

Water supplied by the District, for whatever needs and uses, shall be paid for in accordance with the rates and rules of the District. The only exception is by written agreement with the District.

PART 2 MATERIALS

2.01 NATIVE EARTH BACKFILL - TRENCH ZONE

Native earth backfill used above the pipe zone shall be excavated fine grained materials or loose soil free of asbestos, organic matter, roots, debris, rocks larger than 4 inches in diameter, clods, clay balls, broken pavement, and other deleterious materials. Backfill material shall be so graded that at least 40% of the material passes a No. 4 sieve. The coarser materials shall be well distributed throughout the finer material. Backfill materials that are obtained from trench excavated materials to the extent such material is available, shall be screened at the discretion of the District Engineer during the trenching operation.
If screened during trenching, the material shall be maintained free of unscreened material during the handling and backfilling process. Hand selecting of rocks from earth as it is placed into the trench will not be permitted in lieu of the specified screening. Under no circumstances will native earth backfill be allowed or used in the pipe base area, pipe zone area, or directly under paved roads.

2.02 IMPORTED MATERIAL FOR BACKFILL - TRENCH ZONE

Imported material shall conform to that specified for native earth backfill or imported sand.

2.03 IMPORTED SAND - PIPE BEDDING AND PIPE ZONE

Imported sand used in the pipe base and pipe zone shall consist of natural or manufactured granular material, or a combination thereof, free of deleterious amounts of organic material, mica, loam, clay, and other substances. Decomposed granite or native earth backfill will only be allowed or used in the pipe base or pipe zone areas where specifically approved by the District Engineer. The material must have been tested to a minimum Sand Equivalent of 30 within two (2) weeks of its use. Imported sand shall have the following gradation or similar:

Sieve Size	Percent Passing By Weight
3/8-inch	100
No.4	75 -100
No.30	12 - 50
No.100	5 - 20
No.200	0 - 15

2.04 ROCK REFILL FOR FOUNDATION STABILIZATION

Rock refill shall be crushed or natural rock having the following gradation:

Sieve Size	Percent Passing By Weight
3 inches	100
1-1/2 inches	70 -100
3/4-inch	60 -100
No.4	25 - 55
No.30	10 - 30
No.200	0 - 15

2.05 GRANULAR MATERIAL FOR STRUCTURAL BACKFILL

A. Granular material for structural backfill shall be free of asbestos, organic materials, clay balls, and shall have the following gradation:

Sieve Size	Percent Passing By Weight
3/4-inch	100
1/2-inch	95 -100
3/8-inch	50 -100
No.4	20 - 65
No.8	10 - 40
No.40	0 - 20
No.200	0 - 5

B. Whenever the phrase "structural backfill material" is used in these Standard Specifications, it shall mean granular material for structural backfill as described above.

C. Excavated material may be used for structural backfill provided it conforms to the Standard Specifications for structural backfill material.

2.06 CONCRETE FOR BELOW GROUND INSTALLATIONS

A. Concrete for anchors, collars, encasements, supports, and thrust blocks shall be Class A for reinforced items and Class C for un-reinforced items per Standard Specification Section 03300, except use rapid set concrete mix where indicated.

B. Provide anchor blocks at valves in pipe having rubber gasket bell and spigot or unrestrained mechanical joints.

C. Provide thrust or anchor blocks at all vertical or horizontal bends unless other restraint means are approved by the District Engineer.

2.07 TRENCH CUT-OFF WALLS

A. Provide ASTM C 90, Grade N-I, hollow load-bearing concrete masonry units, medium weight, moisture controlled, average compressive strength over gross area of 1,000 psi. Nominal face dimensions: 8-inches by 8-inches by 16-inches.

B. Provide ladder steel conforming to ASTM A 82.

C. Mortar and grout shall be a mixture of cement, sand, and water. Mortar shall consist of not more than one part cement to two and one-half parts sand by damp loose volume. The quantity of mixing water shall be no more than necessary for handling and placing.

PART 3 EXECUTION

3.01 COMPACTION REQUIREMENTS

Unless otherwise shown on the Drawings, otherwise described in the Specifications, or required by the agency having jurisdiction over the area of the work, relative compaction in pipe trenches shall be a minimum as follows:

Pipe Bedding	90% relative compaction
Pipe Zone	90% relative compaction
Trench Zone	95% relative compaction
Upper Zone	95% relative compaction

3.02 SHEETING, SHORING, AND BRACING OF TRENCHES

Trenches shall have sheeting, shoring, and bracing conforming California Occupational and Health Administration (Cal-OSHA) - California Code of Regulations (CCR) Title 8, and the District's requirements.

3.03 SIDEWALK, PAVEMENT, AND CURB REMOVAL

Cut and remove bituminous and concrete pavements regardless of the thickness, and curbs and sidewalks, prior to excavation of trenches with a pavement saw, hydrohammer, or pneumatic pavement cutter. Width of the pavement cut shall be at least equal to the required width of the trench at ground surface. Haul pavement and concrete materials from the site. Do not use for trench backfill.

3.04 BLASTING

Blasting operations will not be allowed unless approved by the District Engineer.

3.05 DEWATERING

A. Provide and maintain means and devices to remove and dispose of all water entering the trench excavation during the time the trench is being prepared for the pipelaying, during the laying of the pipe, until cement mortar of exterior joints has set hard, when concrete is being deposited and during the hydration process, and until the backfill at the pipe zone and trench zone has been completed. These provisions shall apply during the noon hour as well as overnight. Dispose of the water in a manner to prevent damage to adjacent property and in accordance with regulatory agency requirements. Do not drain trench water through the pipeline under construction.

B. The contractor is responsible for meeting all Federal, State, County, and local laws, rules and regulations regarding the treatment and disposal of water from dewatering operations at the construction site.

3.06 MATERIAL REPLACEMENT

Remove and replace any trenching and backfilling material which does not meet the Specifications, at the Contractor's expense.

3.07 TRENCH WIDTHS

Pipe trench widths in the pipe zone will be limited as follows:

Pipe Diameter	Minimum Trench Width	Maximum Trench Width
4" through 12"	O.D. + 12"	O.D. + 16"
14" through 48"	O.D. + 16"	O.D. + 24"

Trench width at the top of the trench will not be limited except where width of excavation would undercut adjacent structures and footings. In such case, width of trench shall be such that there is at least 2 feet between the top edge of the trench and the structure or footing. Where shoring or encasement is required, trench widths shall be increased accordingly.

3.08 TRENCH EXCAVATION

A. Perform all excavation regardless of the type, nature, or condition of the material encountered to accomplish the construction. Do not operate excavation equipment within 5 feet of existing structures or newly completed construction. Excavate with hand tools in these areas.

B. Excavate the trench to the lines and grades shown on the Drawings with allowance for pipe thickness, sheeting and shoring if used, and for pipe base. If the trench is excavated below the required subgrade, refill any part of the trench excavated below the subgrade at no additional cost to the District with imported sand. Place the refilling material over the full width of trench in compacted layers not exceeding 6-inches deep to the established grade with allowance for the pipe base.

C. Trench depth shall accommodate the pipe and the pipe base at the elevations shown in the profile on the Drawings. No pipe shall be installed without a designed profile unless approved by the District Engineer.

D. Construct trenches in rock by removing rock to a minimum of 6-inches below bottom of pipe and backfilling with imported sand.

3.09 LOCATION OF EXCAVATED MATERIAL

During trench excavation, place the excavated material only within the working area or within the areas shown on the Drawings. Do not obstruct any roadways or streets. Conform to federal, state, and local codes governing the safe loading of trenches with excavated material.

3.10 LENGTH OF OPEN TRENCH

A. The total length of open trench shall not exceed 600-feet including excavation, pipeline installation and backfill in any one location.

B. Where pipelines are located beneath or adjacent to existing paved roads, backfill all trenches at the end of each workday and place temporary or first layer of paving. Clean all new and adjacent existing paved surfaces of residual excavated and backfill materials. Perform dust control operations in these areas with a vacuum type mobile street sweeper. No open trenches will be allowed in these areas.

C. Provide ingress and egress to buildings and property at all times. Provide steel covering for vehicular access in accordance with the County of San Diego Public Works requirements.

3.11 FOUNDATION STABILIZATION

After the required excavation has been completed, the District Engineer will inspect the exposed subgrade to determine the need for any additional excavation. It is the intent that additional excavation be conducted in all areas within the influence of the pipeline where unacceptable materials such as soft, spongy or deleterious materials exist at the exposed grade. Over excavation shall include the removal of all such unacceptable material that exists directly beneath the pipeline to a minimum width equal to the maximum trench width and to a depth determined by the District Engineer. Backfill the trench to the established subgrade of the pipe base with rock refill material for foundation stabilization. Place the foundation stabilization material over the full width of the trench and compact in layers not exceeding 6-inches deep to the required grade. Place imported sand on the compacted foundation stabilization and apply water to wash the sand into the voids of the rock refill material. Continue this procedure until the voids of the rock refill have been filled with imported sand. Do not apply water in such quantities that it will damage the integrity of the pipeline or other improvements.

3.12 CONCRETE FOR BELOW GROUND INSTALLATIONS

Encase pipe with concrete to the line and dimensions indicated or place concrete between the undisturbed ground and the pipe or fittings to be restrained or supported. Quantity or bearing area of the concrete against undisturbed ground shall be as shown on the Standard Drawings, Drawings, or as directed by the District Engineer. Provide temporary support on the pipe, fittings, or valves until the concrete has obtained a 3-day cure. Place concrete such that the pipe joints, fittings, or valves are accessible for repairs. Spade or rod the concrete during placement to eliminate honeycombing. Backfilling of the trench adjacent to the concrete will not be allowed until the concrete has cured for at least 3 days. Allow concrete to cure for at least 7 days prior to subjecting the concrete to pipeline pressure. Where rapid set concrete mix has been used, the 3-day and 7-day cure time is not required. Backfill the rapid set concrete mix as soon as the concrete is hard (approximately one to two hours) and place pipeline into service.

3.13 TRENCH CUT-OFF WALLS

Install trench cut-off walls at the locations shown on the Drawings, and at 20 feet on center on slopes 30% and steeper and with the District's consultation slopes steeper than 50%. Hand cut trench walls to form a neat slot into which the concrete blocks can be laid as tight as possible to the downhill side. Place concrete blocks in horizontal layers and reinforce with ladder steel as the wall is laid. Lay blocks full-bedded in mortar to prevent leakage of grout. All head joints shall be solidly filled with mortar. Cut blocks to fit around the pipe and mortar in place. Provide weep holes in the wall to relieve hydrostatic pressure. Provide one 1/2-inch diameter weep hole for each 1.5 square foot of wall in the trench pipe zone. Grout solid all cells of the wall. Place backfill in layers being evenly brought up on each side of

the cut-off wall. Compact by hand tamping. Give special attention to placing backfill in slot in trench walls.

3.14 TRENCH BACKFILLING

A. Place the specified thickness of pipe bedding material over the full width of trench and compact to the specified relative compaction. Grade the top of the pipe base ahead of the pipelaying to provide firm, continuous, uniform support along the full length of the trench for the pipe, fittings, and valves.

B. Excavate bell holes at each joint to permit proper assembly and inspection of the entire joint. Fill and compact the area excavated for the joints with the pipe base material.

C. After the pipeline has been bedded and the cement mortar used in the exterior joints has set hard, place pipe zone material simultaneously on both sides of the pipe, fittings, and valves, keeping the level of backfill the same on each side. Carefully place the material around the pipe so that the pipe barrel is completely supported and that no voids or un-compacted areas are left beneath the pipe. Use particular care in placing material on the underside of the pipe to prevent lateral movement during subsequent backfilling. Do not drop sharp, heavy pieces of material directly onto the pipe or the tamped material around the pipe.

D. Compact material in the pipe zone by hand tamping only. Care shall be exercised in backfilling to avoid damage to pipe coatings and polyethylene encasement.

E. Push the native earth backfill or imported material for backfill carefully onto the imported sand previously placed in the pipe zone. Do not permit free fall of the material until at least 2 feet of cover is provided over the top of the pipe. Compact backfill material in the trench zone to the specified relative compaction by mechanical compaction or hand tamping.

F. Place and compact pipe zone material in layers not exceeding 12-inches of compacted thickness. Place and compact native earth or imported material for backfill in the middle zone in layers not exceeding 6-inches of compacted thickness.

3.15 MECHANICAL COMPACTION OR HAND TAMPING

Place imported sand and backfill materials, per Part 2, in uniform layers of the indicated thickness. Compact each layer to the required minimum relative compaction at the optimum moisture content. Do not use heavy duty compaction equipment with an overall weight in excess of 125 pounds until backfill has been completed to a depth of 2 feet over the top of pipe. Do not use high impact hammer type equipment except where the pipe manufacturer warrants in writing that such use will not damage the pipe.

3.16 DISPOSAL OF EXCESS EXCAVATED MATERIAL

Dispose of excess excavated material offsite. Contractor shall make his own arrangements for the disposal of the excess material and bear all costs incidental to such disposal.

3.17 TRENCHING RESURFACING

A. Thickness of asphalt concrete resurfacing shall be 1-inch greater than the depth of the existing asphalt, to a maximum of 7-inches, or a minimum of 3-inches whichever is greater.

B. Base material shall be replaced to the depth of the existing base or a minimum of 6-inches which ever is greater.

C. Trench resurfacing shall be done in accordance with FPUD Standard Drawings W-21 and S-15.

3.18 FINAL CLEAN-UP

A. After backfilling, grade the right-of-way to the contours of the original ground and match the adjacent undisturbed ground. Make surfaces free of all cleared vegetation, rubbish and other construction wastes. Dispose of all excavated or surface rocks and lumps which cannot be readily covered by spreading. On slopes 15% and steeper or where rainfall would create an erosion problem as determined by the District's Representative, provide cut off walls per FPUD Standard Drawing.

B. Replace street improvements in kind, such as curbs and gutters, monuments, barricades, traffic islands, signalization, fences, signs, mail boxes, etcetera that are cut, removed, damaged, or otherwise disturbed by the construction.

3.19 SLOPE PROTECTION

A. Install slope protection as required by the agency of jurisdiction. Prepare and seed all open ground within the easement or working area disturbed by the construction, not otherwise protected from erosion, or as determined by the District Engineer. After final clean-up, cultivate areas to be seeded to break up any compaction resulting from grading operations.

B. Cover areas to be seeded with a mulch of rice, wheat, oats, or barley straw spread uniformly at the rate of 2 tons per acre for new straw. If stable bedding straw is used, spread uniformly at the rate of 3 tons per acre. Roll straw with stud roller to produce a uniform ground surface, incorporating the straw into the soil so as not to support combustion or to be blown from the area by winds. Seed the mulched areas with a mixture of 32 pounds of barley and 32 pounds of western rye grass seed per acre. Seed shall be 95% pure and have a minimum of 85% germination.

C. Unimproved areas disturbed during construction of the pipeline or appurtenances may be hydro seeded at the District Engineer's discretion. An example of a seed mixture list for coastal sage scrub re-vegetation is as follows:

BOTANICAL NAME	COMMON NAME	lbs/acre
Eriogonum Fasiculatum	Flat-Top Buckwheat	2.0
Artemisia Californica	California Sagebrush	8.0
Lotus Scoparius	Deerweed	5.0
Salvia Apiana	White Sage	1.0
Eriophyllum Confertiflorum	Golden Yarrow	2.0
Yucca Whipplei	Our Lord's Candle	0.5
Vulpia Muralis 'Zorro'	Zorro Fescue	8.0
Plantago (Insolaris) Ovata	Plantain	3.0
Eschscholzia Californica	California Poppy	3.0
Lupinus Hirsutissimus	Stinging Lupine	3.0
Phacelia Parryi	Bluebells	1.0

D. The hydro seed mix shall be a bonded matrix consisting of wood fiber, fertilize and high quality live seed in the following proportions:

SEED	SEE ABOVE
Fiber Mulch	2,000 lbs/acre
Slow Release Fertilizer	150 lbs/acre
Soil Binder(Mix soil Binder at the rate of 1-lb per 25 gals)	100 lbs/acre

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 DESCRIPTION

This section describes materials and methods for formwork, reinforcement, mixing, placement, curing and repairs of concrete, and the use of cementations materials and other related products. This section includes concrete, mortar, grout, reinforcement, thrust and anchor blocks, valve support blocks and manhole bases.

1.02 REFERENCE STANDARDS

The publications listed below form part of this specification to the extent referenced and are referred to in the text by the basic designation only. Reference shall be made to the latest edition of said standards unless otherwise called for.

ASTM A 185	Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM A 615/A 615M	Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM C 150	Specification for Portland Cement
ASTM C 494	Specification for Chemical Admixtures for Concrete
ASTM C 881	Specification for Epoxy-Resin-Base Bonding Systems for Concrete
CRSI	Recommended Practice for Placing Reinforcing Bars
SSPWC	Standard Specifications for Public Works Construction "Greenbook" (Current Version)

1.03 RELATED WORK SPECIFIED ELSEWHERE

FPUD	Standard Drawings
Section 02223	Trenching, Backfilling and Compacting
Section 03461	Precast Concrete Manholes

1.04 APPLICATIONS

The following materials, referenced in other sections, shall be provided and installed in accordance with this specification for the applications noted below:

A. Concrete for thrust and anchor blocks for horizontal and vertical bends, ductile-iron or steel fittings, fire hydrant bury ells, and support blocks for valves 4-inch and larger, all in accordance with the Standard Drawings.

B. Concrete for collars, cradles, curbs, encasements, gutters, manhole bases, protection posts, sidewalks, splash pads, and other miscellaneous cast-in-place items.

C. Mortar for filling and finishing the joints between manhole and vault sections and setting manhole grade rings and cover frames. Mortar may also be used for repairs of minor surface defects of no more than 1/4-inch in depth or 1/2-inch in width on non-structural, cast-in-place items such as splash pads or concrete rings around manholes. (Note that large voids, structural concrete and pipe penetrations into vaults shall be repaired with non-shrink grout; repairs to precast manholes and vaults and cast-in-place manhole bases shall be repaired with an epoxy bonding agent and repair mortar, as outlined below.)

D. Epoxy bonding agent for bonding repair mortar to concrete on repairs to damaged surfaces of precast or cast-in-place concrete manholes and vaults.

E. Repair mortar for repair to damaged surfaces of precast or cast-in-place concrete manholes and vaults. An epoxy bonding agent shall be used in conjunction with repair mortar.

F. Non-shrink grout for general purpose repair of large construction voids, pipe penetrations into vaults and grouting of base plates for equipment or structural members.

G. Epoxy adhesives for grouting of anchor bolts.

H. Protective epoxy coating for application to reinforcing steel within existing concrete structures exposed during construction.

I. Damp-proofing for application to the exterior surfaces of concrete manholes and vaults located at or below the water table or where showing evidence of moisture or seepage, and as directed by the District Engineer.

J. New construction and repairs use Con Shield MS-10,000 with Con mic Shield.

1.05 DELIVERY, STORAGE AND HANDLING

Deliver reinforcing steel to the site bundled and tagged with identification. Store on skids to keep bars clean and free of mud and debris. If contaminated, all bars shall be cleaned by wire brushing, sand blasting, or other means prior to being set in forms.

PART 2 MATERIALS

2.01 CONCRETE

A. All Portland cement concrete shall conform to the provisions of Sections 201, 202 and 303 of the Standard Specifications for Public Work Construction (Greenbook).

B. Class 560-C-3250 concrete, as described in the Greenbook, Section 201, shall be used for all applications unless otherwise directed by the District Engineer. The maximum water/cement ratio shall be 0.53 by weight, and the maximum slump shall be 4-inch.

C. In certain circumstances, rapid-setting concrete may be required. Accelerating admixtures shall conform to ASTM C-494 and may be used in the concrete mix as permitted by the District Engineer. Calcium chloride shall not be used in concrete.

D. Where concrete is needed to resist microbial induced corrosion of sewer structures an antimicrobial agent, Con^{MIC} Shield®, or approved equal, shall be used to render the concrete uninhabitable for bacterial growth. The liquid antibacterial additive shall be an EPA

registered material and the registration number shall be submitted for approval prior to use in the project. The amount to be used shall be as recommended by the manufacturer of the antibacterial additive. This amount shall be included in the total water content of the concrete mix design. The additive shall be added into the concrete mix water to insure even distribution of the additive throughout the concrete mixture. A letter of certification must be submitted stating that the correct amount and correct mixing procedure was followed of all antimicrobial concrete.

2.02 REINFORCING STEEL

A. Reinforcing steel shall conform to ASTM A 615, Grade 60.

B. Fabricate reinforcing steel in accordance with the current edition of the Manual of Standard Practice, published by the Concrete Reinforcing Steel Institute.

2.03 WELDED WIRE FABRIC

Welded wire fabric shall conform to ASTM A 185.

2.04 TIE WIRE

Tie wire shall be 16-gage minimum, black, soft annealed.

2.05 BAR SUPPORTS

Bar supports in beams and slabs exposed to view after removal of forms shall be galvanized or plastic coated. Use concrete supports for reinforcing in concrete placed on grade.

2.06 FORMS

A. Forms shall be accurately constructed of clean lumber. The surface of forms against which concrete is placed shall be smooth and free from irregularities, dents, sags or holes.

B. Metal form systems may be used upon approval from the District Engineer. Include manufacturer's data for materials and installation with the request to use a metal form system.

2.07 MORTAR

Cement mortar shall consist of a mixture of Portland cement, sand and water. One (1) part cement and two (2) parts sand shall first be combined, and then thoroughly mixed with the required amount of water.

2.08 EPOXY BONDING AGENT

The epoxy bonding agent shall be an epoxy-resin-based product intended for bonding new mortar to hardened concrete and shall conform to ASTM C 881. The bonding agent shall be selected from the Approved Materials List.

2.09 REPAIR MORTAR

Repair mortar shall be a two-component, cement-based product specifically designed for structurally repairing damaged concrete surfaces. The repair mortar shall exhibit the properties of

high compressive and bond strengths and low shrinkage. A medium-slump repair mortar shall be used on horizontal surfaces, and a non-sag, low-slump repair mortar shall be used on vertical or overhead surfaces. Repair mortar shall be selected from the Approved Materials List.

2.10 NON-SHRINK GROUT

Non-shrink grout shall be a non-metallic cement-based product intended for filling general construction voids or grouting of base plates for equipment or structural members. The non-shrink grout shall exhibit the properties of high compressive and bond strengths and zero shrinkage, and shall be capable of mixing to a variable viscosity ranging from a dry pack to a fluid consistency as required for the application. The non-shrink grout shall be selected from the Approved Materials List.

2.11 EPOXY ADHESIVE

Epoxy adhesive shall be a high-modulus epoxy-resin-based product intended for structural grouting of anchor bolts and dowels to concrete. The epoxy adhesives shall conform to ASTM C 881. A pourable, medium-viscosity epoxy shall be used on horizontal surfaces, and a heavy-bodied, non-sag epoxy gel shall be used on vertical surfaces. The epoxy adhesives shall be selected from the Approved Materials List.

2.12 PROTECTIVE EPOXY COATING

The protective epoxy coating shall be an epoxy-resin-based product exhibiting high bond strength to steel and concrete surfaces, and shall conform to ASTM C 881. The protective epoxy coating shall be selected from the Approved Materials List.

2.13 DAMP-PROOFING FOR CONCRETE STRUCTURES

Damp-proofing material shall consist of two (2) coats of a single-component self-priming, heavy-duty cold-applied coal tar selected from the Approved Materials List.

PART 3 EXECUTION

3.01 FORMWORK

A. The Contractor shall notify the District Engineer a minimum of one (1) working day in advance of intended placement of concrete to enable the District Engineer to check the form lines, grades, and other required items before placement of concrete.

B. The form surfaces shall be cleaned and coated withVOC compliant form release oil prior to installation. The form surfaces shall leave uniform form marks conforming to the general lines of the structure.

C. The forms shall be braced to provide sufficient strength and rigidity to hold the concrete and to withstand the necessary fluid pressure and consolidation pressures without deflection from the prescribed lines.

D. Unless otherwise indicated on the plans, all exposed sharp concrete edges shall be 1/4-inch chamfered.

3.02 REINFORCEMENT

A. Place reinforcing steel in accordance with the current edition of Recommended Practice for Placing Reinforcing Bars, published by the Concrete Reinforcing Steel Institute.

B. All reinforcing steel shall be of the required sizes and shapes and placed where shown on the drawings or as directed by the District Engineer.

C. Do not straighten or re-bend reinforcing steel in a manner that will damage the material. Do not use bars with bends not shown on the drawings. All steel shall be cold bent – do not use heat.

D. All bars shall be free from rust, scale, oil, or any other coating that would reduce or destroy the bond between concrete and steel.

E. Position reinforcing steel in accordance with the Approved Plans and secure by using annealed wire ties or clips at intersections and support by concrete or metal supports, spacers, or metal hangers. Do not place metal clips or supports in contact with the forms. Bend tie wires away from the forms in order to provide the concrete coverage equal to that required of the bars. If required by the District Engineer, the Contractor shall install bars additional to those shown on the drawings for the purpose of securing reinforcement in position.

F. Place reinforcement a minimum of 2-inch clear of any metal pipe, fittings, or exposed surfaces.

G. The reinforcement shall be so secured in position that it will not be displaced during the placement of concrete.

H. All reinforcing steel, wire mesh, and tie wire shall be completely encased in concrete.

I. Reinforcing steel shall not be welded unless specifically required by the Approved Plans or otherwise directed by the District Engineer.

J. Secure reinforcing dowels in place prior to placing concrete. Do not press dowels into the concrete after the concrete has been placed.

K. Minimum lap for all reinforcement shall be 40 bar diameters unless otherwise specified on the Approved Plans.

L. Place additional reinforcement around pipe penetrations or openings 6-inch diameter or larger. Replace cut bars with a minimum of 1/2 of the number of cut bars at each side of the opening, each face, each way, same size. Lap with the uncut bars a minimum of 40 bar diameters past the opening dimension. Place one (1) same size diagonal bar at the four (4) diagonals of the opening at 45° to the cut bars, each face. Extend each diagonal bar a minimum of 40 bar diameters past the opening dimension.

M. Wire mesh reinforcement is to be rolled flat before being placed in the form. Support and tie wire mesh to prevent movement during concrete placement.

N. Extend welded wire fabric to within 2-inch of the edges of slabs. Lap splices at least 1-1/2 courses of the fabric and a minimum of 6-inch. Tie laps and splices securely at ends and at

least every 24-inch with 16-gage black annealed steel wire. Pull the fabric into position as the concrete is placed by means of hooks, and work concrete under the steel to ensure that it is at the proper distance above the bottom of the slab.

3.03 EMBEDDED ITEMS

All embedded items, including bolts, dowels and anchors, shall be held correctly in place in the forms before concrete is placed.

3.04 MORTAR MIXING

The quantity of water to be used in the preparation of mortar shall be only that required to produce a mixture sufficiently workable for the purpose intended. Mortar shall be used as soon as possible after mixing and shall show no visible sign of setting prior to use. Re-mixing of mortar by the addition of water after signs of setting are evident shall not be permitted.

3.05 MIXING AND PLACING CONCRETE

A. All concrete shall be placed in forms before taking its initial set.

B. No concrete shall be placed in water except with permission of the District Engineer.

C. As the concrete is placed in forms, or in rough excavations (i.e., thrust or anchor blocks), it shall be thoroughly settled and compacted throughout the entire layer by internal vibration and tamping bars.

D. All existing concrete surfaces upon which or against which new concrete is to be placed shall be roughened, thoroughly cleaned, wetted, and grouted before the new concrete is deposited.

3.06 CONCRETE FINISHING

A. Immediately upon the removal of forms, voids shall be neatly filled with cement mortar, non-shrink grout, or epoxy bonding agent and repair mortar as required for the application and as directed by the District Engineer.

B. The surfaces of concrete exposed to view shall be smooth and free from projections or depressions.

C. Exposed surfaces of concrete not placed against forms, such as horizontal or sloping surfaces, shall be Screeded to a uniform surface, steel-troweled to density the surface, and finished to a light broom finish.

3.07 PROTECTION AND CURING OF CONCRETE

The Contractor shall protect all concrete against damage. Exposed surfaces of new concrete shall be protected from the direct rays of the sun by covering them with plastic film wrap and by keeping them damp for at least 7 days after the concrete has been placed, or by using an approved curing process. Exposed surfaces shall be protected from frost by covering with tarps for at least 5 days after placing.

3.08 REPAIRS TO DAMAGED CONCRETE SURFACES

Minor surface damage to hardened cast-in-place or precast concrete may be repaired, at the discretion of the District Engineer, using the specified materials in accordance with the manufacturer's recommendations and the following procedures:

A. Cast-in-place or precast concrete for manholes and vaults: Remove loose or deteriorated concrete to expose a fractured aggregate surface with an edge cut to a ninety degree angle to the existing surface. Clean all debris from the area, apply a 20 mil coat of epoxy bonding agent to the prepared surface, and place repair mortar while the epoxy is still wet and tacky. On horizontal surfaces, for repair depths greater than 2-inch, add aggregate to the repair mortar as recommended by the manufacturer. On vertical or overhead surfaces, for repair depths greater than 2-inch, apply the repair mortar in successive lifts, scarifying the lifts, allowing them to harden, and applying a scrub coat of the material prior to proceeding with the next lift. Cure the material as for concrete in accordance with this specification.

B. General Purpose: Remove loose and deteriorated concrete by mechanical means, sandblasting or high-pressure water blasting. Clean all debris from the area and apply non-shrink grout in a 1/4-inch minimum thickness, at the desired consistency, ranging from a dry pack, to a fluid-poured into a formed area, according to the application. Cure the material as for concrete in accordance with this specification.

3.09 EPOXY ADHESIVES FOR ANCHOR BOLT INSTALLATION

Anchor bolts grouted in place with an epoxy adhesive shall be installed using the specified materials in accordance with the manufacturer's recommendations and the following general procedures: Drill the hole with a rotary percussion drill to produce a rough, unpolished hole surface. The hole shall be sized to the manufacturer's recommendations and shall be approximately 1/4-inch wider than the diameter of the bolt, with a depth equal to 10 to 15 times the bolt diameter. Remove debris and dust with a stiff bristle brush and clean using compressed air. Utilizing a medium-viscosity epoxy for horizontal surfaces, and a gel-type non-sag epoxy for vertical surfaces, apply the material to fill the hole to approximately half its depth. Insert the bolt, forcing it down until the required embedment depth and projection length are attained and then twist the bolt to establish a bond. Secure the bolt firmly in place in the permanent position until the epoxy sets.

3.10 PROTECTIVE EPOXY COATING

Following core drilling at existing concrete structures, clean the exposed concrete surface and ends of reinforcing steel and apply two (2) coats of protective epoxy coating for a total dry film thickness of 10-15 mils. Allow the material to cure between coats and prior to continuing the installation through the penetration.

3.11 DAMP-PROOFING THE EXTERIOR OF CONCRETE STRUCTURES

Following completion of the exterior surfaces of manholes and vaults, including necessary repairs and piping penetrations into the structure, apply the specified material to prepared concrete surfaces in accordance with the manufacturer's recommendations. The surfaces to be coated shall be fully cured and free of laitance and contamination. The material shall be applied to all exterior surfaces below a point 12-inch above the water table or indications of seepage or moisture as directed by the Engineer. Apply two 15 mil coats, curing between coats, prior to backfill and/or immersion in accordance with the manufacturer's recommendations.

3.12 THRUST AND ANCHOR BLOCKS

Concrete thrust and anchor blocks shall be placed against wetted, undisturbed soil in accordance with the Standard Drawings and as directed by the District. The concrete shall be placed so that fittings and valves will be accessible for repairs or replacement. Prior to filling the pipeline with water, the concrete for thrust and anchor blocks shall cure for the following number of days:

Thrust Blocks	3 days minimum
Anchor Blocks	7 days minimum

A. Pipe Thrust:

The following table lists the minimum bearing area (in square feet) for the noted fitting for each pipe size. The area shown is for each 100psi of test pressure, assuming a soil bearing pressure of 2,000psi. (For instance, if the test pressure is required to be 250psi, multiply the value in the table by 2.5.)

Pipe Size	Tees and Dead Ends	90° Bend	45° Bend	22½° Bend	11¼° Bend
6-inch	3.7	5.3	2.9	1.5	0.7
8-inch	6.4	9.1	4.9	2.5	1.3
10-inch	9.7	13.7	7.4	3.8	1.9
12-inch	13.7	19.4	10.5	5.3	2.7
14-inch	18.4	26.0	14.1	7.2	3.6
16-inch	23.8	33.6	18.2	9.3	4.7
18-inch	24.9	42.2	22.9	11.7	5.9
20-inch	36.6	51.8	28.0	14.3	7.2
24-inch	52.3	73.9	40.0	20.4	10.2
30-inch	80.4	113.7	61.6	31.4	15.8

B. Thrust Block Placement and Sizing:

Thrust blocks shall be located at all unrestrained pipe fittings and bear against firm, undisturbed soil. The thrust blocks shall be centered on the fitting so that the bearing area is exactly opposite the resultant direction of the thrust, refer to the Standard Drawings. Care shall be taken to prevent the placed thrust block concrete from eliminating maintenance access to the valve operators. All thrust block excavation, location, shape, and size shall be verified by the District Engineer prior to pouring concrete. The size shall be as indicated in Paragraph A above.

C. Anchor Block Placement and Sizing:

For all vertical bends in pipelines (downward bends) that do not have restrained joints, the fittings shall be retained in place by means of an anchor block. The block shall be sized to withstand the thrust exerted for the particular deflection angle at the required test pressure plus 10%. (Do not rely on the restraining benefit from the soil). The District Engineer shall verify the size chosen and the reinforcing steel required.

3.13 VALVE SUPPORT BLOCKS

Valve support blocks shall be installed as described below and in accordance with the Standard Drawings:

A. Support blocks below valves shall be cut into the side of the trench a minimum of 12-inch.

B. Support blocks shall extend up to the height of adjoining pipe and shall have a minimum depth below the valve of 12-inch.

C. Support blocks shall be installed so that the valves will be accessible for repairs.

END OF SECTION

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SECTION 03461

PRECAST CONCRETE MANHOLES

PART 1 GENERAL

1.01 DESCRIPTION

This section includes materials, testing, and installation of precast concrete manholes for sewers and appurtenances.

1.02 REFERENCE STANDARDS

The publications listed below form part of this specification to the extent referenced and are referred to in the text by the basic designation only. Reference shall be made to the latest edition of said standards unless otherwise called for:

ASTM A 48	Gray Iron Castings
ASTM C 478	Precast Reinforced Concrete Manhole Sections
ASTM C 478M	Precast Reinforced Concrete Manhole Sections [Metric]
ASTM C 923	Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals

1.03 RELATED WORK SPECIFIED ELSEWHERE

FPUD	Standard Drawings
Section 02223	Trenching, Backfilling and Compacting
Section 03300	Cast-in-Place Concrete

1.04 ACCESS MANHOLES FOR SEWER MAINS

60-inch diameter shall be used for all sewer applications. Refer to Design Manual, Paragraph 2.03, Subparagraph D, Manholes.

1.05 DROP MANHOLES

The District Engineer must approve all drop manholes.

1.06 CORROSION PROTECTION

A corrosion protection lining and/or coating as described in this specification, shall be applied to the interior of manholes for 1) all new manholes on sewer mains, 2) all drop manholes, 3) all existing manholes receiving a new connection, and 4) all manholes within 1,000 feet of receiving a force main discharge.

1.07 DAMP-PROOFING

A damp-proofing material shall be applied to the exterior portions of manholes in accordance with Section 03300 and as directed by the District Engineer when located at or below the water table or when moisture or seepage is indicated.

1.08 JOINT SEALING

Joint sealant shall be used to form a continuous watertight seal on the concrete base and between successive precast concrete manhole or vault sections.

1.09 SAFETY GRATING

A safety grating shall be provided above the drain channels in manholes and drop manholes for sewer mains 18-inch and larger. Safety grating shall be installed only in locations shown on the plans or as called for by the District Engineer.

1.10 VACUUM TESTING OF MANHOLES

Vacuum testing of manholes is intended for testing precast concrete manhole sections to demonstrate the integrity of the installed materials and construction procedures.

PART 2 MATERIALS

2.01 PRECAST CONCRETE MANHOLES

A. Precast components and other appurtenant materials shall be selected from the Approved Materials List.

B. Precast concrete manhole components shall be in accordance with ASTM C 478 and the Standard Drawings.

C. The antimicrobial agen, Con^{MIC} Shielded®, or approved equal, shall be used to render the concrete uninhabitable for bacteria growth. The liquid antibacterial additive shall be an EPA registered material and the registration number shall be submitted for approval prior to use in the project. The amount to be used shall be as recommended by the manufacturer of the antibacterial additive. This amount shall be included in the total water content of the concrete mix design. The additive shall be added into the concrete mix water to insure even distribution of the additive throughout the concrete mixture. A letter of certification must be submitted stating that the correct amount and correct mixing procedure was followed based on manufacturers' recommendations.

D. Manhole components shall be designed for H-20 highway wheel loading and specific site conditions.

E. Manhole bases shall be cast-in-place with a formed recess shaped to match the first precast shaft section. The manhole base shall extend 12-inches below the bottom of the lowest pipe and 6-inches above the top of the largest pipe. Manhole bases for mains 18-inch or larger shall incorporate a 4-inch wide grating-support ledge, cast integrally with the drain channels, at the top of the base.

F. Manhole shafts shall be fabricated only from precast shaft sections, eccentric cone sections and grade rings.

G. Pipe penetrations for sewer applications shall incorporate a watertight flexible pipe connector or ring-type seal according to the method of manhole construction as shown in the Standard Drawings. Precast manholes shall utilize either an integrally cast embedded pipe connector, or a boot-type connector installed in a circular block out opening in accordance with ASTM C 923. Connections to existing manholes shall utilize a boot type connector per ASTM C 923 installed in a cored opening. Cast-in-place bases shall incorporate a ring-type seal on the pipe to be embedded in the concrete.

H. Manholes on sewer mains 18-inch or larger, and all drop manholes regardless of the size of the sewer main, shall be polyurethane coated. Precast shaft sections, cone sections and grade rings on manholes shall have a100% solids elastomer polyurethane coating. A 100% solids elastomeric polyurethane coating shall be applied to exposed concrete at the interior of precast and cast-in-place bases.

2.02 CRUSHED ROCK BASE AND BACKFILL MATERIALS

Crushed rock base and backfill materials shall be in accordance with Section 02223.

2.03 MANHOLE FRAMES AND COVERS

A. Manhole frames shall be 36-inch in diameter with two concentric covers, made of cast-iron in accordance with ASTM A 48, Class 30, the Standard Drawings and the Approved Materials List. Locking frames and covers, in accordance with the Standard Drawings are required in remote areas and as determined by the District Engineer.

B. Frames and covers shall be designed for H-20 highway wheel loading.

C. Covers shall have the words 'FPUD' and 'SEWER' cast into the cover as appropriate to the application. No other lettering will be permitted on the top portion of the cover.

D. Castings shall be smooth, clean, and free from blisters, blowholes, and shrinkage. Mating surfaces of the frame and cover shall be machined to prevent movement of the lid. Frames and covers shall be match marked in sets before shipping to the site.

E. All castings shall be dipped twice in a preparation of asphalt or coal tar and oil applied at a temperature of not less than 290° F nor more than 310° F and in such a manner as to form a firm and tenacious coating.

2.04 CONCRETE

Concrete used for manholes and appurtenances shall be in accordance with Section 03300.

2.05 JOINT SEALING COMPOUND

Joint sealing compound shall be a mastic-type material in a flexible rope or rolled form with removable wrapper sized to fit into the key of manhole or vault sections. Joint sealing compound shall be selected from the Approved Materials List.

2.06 REPAIR MORTAR AND EPOXY BONDING AGENT

Repair mortar and an epoxy bonding agent shall be used to repair minor surface damage to precast sections or cast-in-place manhole bases at the discretion of the District Engineer. Repair products shall be in accordance with Section 03300.

2.07 MORTAR

Mortar for use on joints between precast sections and for setting manhole cover frames shall be in accordance with Section 03300.

2.08 DAMP-PROOFING

Damp-proofing material shall be in accordance with Section 03300.

PART 3 EXECUTION

3.01 WORK WITHIN EXISTING MANHOLES

Contractor shall comply with all Federal and State regulations for confined space entry. Work inside confined spaces, as defined by the applicable regulations, shall not be undertaken until all the tests and safety provisions of the Code of Federal Regulations 1910.146, and the General Industry Safety Orders of the California Code of Regulations, Title 8, Section 5159, for confined space entry have been performed and the area is verified as safe to enter. District policy prohibits entry into any confined space with Immediately Dangerous to Life and Health (IDLH) conditions except by trained emergency rescue personnel.

3.02 EARTHWORK

Manhole excavation, foundation stabilization (if necessary), placement of base material, backfill and compaction shall be performed in accordance with Section 02223.

3.03 MANHOLE BASE

A. The invert of the cast-in-place base shall be hand-worked to provide channels conforming in size to the inside diameter of the piping as indicated on the Approved Plans. The channels shall vary uniformly in size and shape from inlet to outlet. The concrete base shall be shaped with a wood float and shall receive a hard steel trowel finish before the concrete sets. A template shall be used to accurately form the level surface that will receive the first precast section.

B. During construction of cast-in-place bases, all sewer mains and stub piping shall be in place, including ring-type seals, before concrete placement. Pipe grade and alignment

shall be verified immediately upon placement of concrete to assure that the pipelines are in proper position prior to the concrete taking an initial set. The invert elevation and flow line of piping shall be as shown on the Approved Plans and Standard Drawings. The manhole base shall extend 12-inches below the bottom of the lowest pipe and 6-inch above the top of the largest pipe.

C. Cast-in-place bases shall set a minimum of 24 hours before the manhole construction is continued. In certain critical situations, the setting time may be reduced upon approval of the District Engineer.

3.04 INSTALLING MANHOLE SECTIONS

A. The concrete manhole base and successive precast sections will receive a mastic joint sealing compound prior to setting the precast sections in place as shown on the Standard Drawings. Following the vacuum testing as described in this section, the joints will be mortared and tooled to a smooth finish, free of voids. Note that sewer manholes are to be vacuum tested following assembly of the concrete sections, but prior to mortaring the joints, or backfilling.

B. Manhole components incorporating a PVC liner and polyurethane coating shall be installed and tested in accordance with these specifications, the manufacturer's recommendations, and the Standard Drawings. Upon assembly of the precast sections and vacuum testing as described in this section, the mortaring and finishing of joints shall be performed. The PVC liner seams at the joints shall then be welded. The PVC liner shall be secured by insertion between the uppermost grade ring and the manhole cover frame. Note that PVC lined sewer manholes are to be vacuum tested following assembly of the concrete sections, but prior to mortaring the joints, welding the seams of the PVC liner, or backfilling. The polyurethane coating of all exposed concrete on the manhole base shall follow completion of the entire installation and all construction activity within the manhole.

C. Assemble the precast sections to the elevation required by the location of the manhole as follows:

1. Paved Areas: Top of cover shall be flush with the finished paving surface.

2. Traveled Way: Top of cover shall be flush with the existing surface where it is in a traveled way.

3. Shoulder Areas: Top of cover shall be 1-inch above the existing surface where outside the limits of a traveled way. Vaults shall not be placed in roadside ditches without the prior approval of the District.

4. Unimproved easements: Top of cover shall be 6-inches above the ground surface. Guard Posts around the vault may be required in this area as directed by the District.

D. Secure the manhole frame to the grade ring with mortar.

E. After the frame is securely set the cover shall be installed. All necessary cleaning of foreign materials from the frames and covers shall be accomplished to ensure a satisfactory fit.

F. Where manholes are to be given a protective coating, they shall be free of seepage and surface moisture.

G. Piping installation adjacent to the manhole and connection to the base or shaft sections shall be performed as shown on the Standard Drawings and Approved Plans. Piping installation into flexible pipe connectors shall be in accordance with the manufacturer's recommendations for assembly, lubricants and limits of deflection.

H. In order to prevent accidental use of the new sewer before completion and acceptance, the new inlet to existing tie-in manhole(s) and the outlet of the first new upstream manhole(s) shall be sealed with expandable plugs. The District Engineer shall approve the specific location of these plugs. Plugs shall be removed at the time of final inspection or as directed by the District Engineer. Removal of all construction debris and water shall be completed prior to removal of plugs.

I. Brick or mortar bulkheads shall be installed by the Contractor at the manhole end of all unused stub channels over 36-inch beyond manhole base. The bulkheads are intended to prevent ponding of sewage and debris in the unused channels until such time as the manhole stub is connected and normal sewage flow can occur.

J. New connections to existing manholes, where stubs have not been provided, shall be made by core drilling through the walls or base as directed by the District Engineer. Flexible seals selected from the Approved Materials List and installed in accordance with the Standard Drawings shall be used for the pipe penetration. Apply a protective epoxy coating to the cored concrete and the ends of any reinforcing steel exposed in accordance with Section 03300.

K. A concrete collar shall be cast around manhole frames in accordance with the Standard Drawings.

L. Replacement of asphalt or concrete pavement shall be in accordance with the requirements of the agency having jurisdiction.

3.05 DAMP-PROOFING

At the discretion of the District Engineer, damp-proofing material shall be applied to the exterior surfaces of manholes in accordance with the manufacturer's recommendations and Section 03300. The material shall be applied to all exterior surfaces below a point 12-inch above the water table or indications of seepage or moisture as directed by the District Engineer.

3.06 VACUUM TESTING OF MANHOLES

A. Vacuum testing of manholes is required and shall be performed as directed in the presence of the District Inspector.

B. Vacuum testing equipment shall be as manufactured by P.A. Glazier, Inc. or equal.

C. Manholes shall be tested after assembly and prior to mortaring the joints or backfilling. In the case of manholes incorporating a PVC liner and polyurethane coating, the testing is to take place prior to mortaring the joints, welding the liner seams between sections, applying the coating, or backfilling.

D. All lift holes shall be plugged with an approved grout prior to testing.

E. All pipes entering the manhole shall be plugged, and bracing installed, to prevent the plug from being drawn into the manhole.

F. The test head shall be placed inside the top of the cone section and the seal inflated in accordance with the manufacturer's recommendations.

G. A vacuum of 10-inches of mercury shall be drawn. The time shall be measured for the vacuum to drop to 9-inches of mercury. The manhole shall pass the test if the time taken for the drop is greater than 60 seconds.

H. If the manhole fails the test, necessary repairs shall be made and the test repeated until acceptable results are obtained. The leak(s) shall be located and repaired according to their nature with material-in-kind.

3.08 HOLIDAY TESTING OF POLYURETHANE-LINED MANHOLES

Polyurethane-coated surfaces shall be holiday tested with an electrical holiday detector as manufactured by Tinker and Rasor (Model #AP-W with power pack) with the instrument set at 20,000 volts and used as directed by the District Engineer. All imperfections identified on the polyurethane coating shall be repaired with materials-in-kind and the test shall be repeated until no holidays are evident.

END OF SECTION

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SECTION 05500

MISCELLANEOUS METALS

PART 1 GENERAL

1.01 DESCRIPTION

This Section includes furnishing and installing miscellaneous metal work as shown on the Drawings and specified in this Section.

1.02 REFERENCE STANDARD

A. The publications and standards referenced herein form a part of the Specifications.

B. When a date is given for reference standards, that edition shall be used. Where no date is given for the reference standards, the latest edition shall be used.

1.03 SUBMITTALS

A. Submittals shall be made in accordance with Specifications Section 01300, Submittals, and the following special provisions provided herein.

B. Shop Drawings. Before beginning fabrication of miscellaneous metal articles, the Contractor shall submit complete shop and erection drawings showing details of methods, materials, and finishes proposed for use. Shop drawings shall give complete information necessary for the fabrication of the component parts of the articles, including the location, type, and size bolts and welds. They shall clearly distinguish between shop and field bolts and welds.

C. Test Reports and Certification documents shall be submitted as follows:

1. Welding Procedure Specifications (WPS), per AWS D1.1, for welding procedures proposed for use in making production welds.
2. Welding Procedure Qualification Record (PQR) to support welding procedures proposed for production welds not otherwise prequalified.
3. Welding Performance Qualification for welders and welding operators to be employed on the Work.
4. Certified mill test reports for chemistry and mechanical properties.
5. Manufacturer's certification verifying conformance to these Specifications and that all products in contact with potable water are NSF-approved.

1.04 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall take reasonable care in the proper handling and storage of articles or materials during erection operations to avoid accumulation of dirt and foreign matter. The Contractor shall remove from the articles or materials, dust, dirt, or other foreign matter that accumulates during construction. Coated surfaces shall be protected from abrasion or other damage during handling, storing, and erecting.

B. Materials taken from stock by the Contractor shall be of a quality at least equal to that required by the ASTM specifications applicable to the classification covering the intended use and shall be supported by test reports prepared at the mill where the material was manufactured or at a testing laboratory approved by the District Engineer.

PART 2 MATERIALS

2.01 STEEL

A. Carbon Steel

1. Structural shapes shall be in accordance with ASTM A36.

2. Bars and shapes shall be in accordance with ASTM A36 or ASTM A108 Grade 1018.

3. Plate 2 inches and less in thickness shall be in accordance with ASTM A36 or ASTM A283 Grade C or Grade D.

B. Stainless Steel

1. All welded stainless steel materials shall be pickled and passivated after fabrication in accordance with the requirements of ASTM A380. The Contractor shall use Avesta, or equal, pickling and passivating solution, for fieldwork.

2. Unless otherwise shown on the Drawings, materials in contact with water, intermittently or continuously, or in a wet or moist environment shall be stainless steel, Type 316 or 316L, where welding is required.

3. Stainless steel bars and shapes shall be in accordance with ASTM A276 Type 316 or Type 316L where welding is required, unless otherwise specified or shown on the Drawings.

4. Stainless steel plate, sheet, and strip shall be in accordance with ASTM A167 Type 316 or Type 316L where welding is required, unless otherwise specified or shown on the Drawings.

5. Rolled stainless steel shapes shall be in accordance with the requirements of ASTM A479, Type 316, or 316L where welding is required, heat treatment waived, unless otherwise specified or shown.

6. Stainless steel pipe shall be in accordance with ASTM A312 Type 316L.

7. Stainless steel tubing shall be in accordance with ASTM A554 Type MT316L.

8. Where shown on the Drawings, age-hardened stainless steel shall be in accordance with ASTM A564 Type 630, cold finished. Heat-treatment or age hardening shall be conducted at 900°F.

9. Stainless steel wire cloth shall conform to the requirements of ASTM E2016, Type 316.

C. Aluminum plate and sheet shall be in accordance with ASTM B209, Alloy No. 5052 H32.

D. Fasteners

1. Threads for bolts and nuts shall be in accordance with ANSI B 1.1.

   a. Threads for bolts 1-inch and less in diameter shall be coarse-thread series and threads for bolts 1 1/8-inch and greater in diameter shall be the 8-pitch thread series.

   b. The fit shall be Class 2 free fit; except that Class 3 medium fit shall be provided in holes tapped for studs.

2. Unless otherwise shown on the Drawings, bolts shall have heavy hexagon heads and heavy hexagon nuts.

3. The lengths of studs and bolts, excluding anchor bolts, shall provide a projection of not less than ¼-inch nor more than ½-inch through the nut when it is drawn tight; however, in exposed locations the projection shall be not more than ¼-inch.

4. Carbon Steel Nuts and Bolts

   a. Carbon steel bolts, anchor bolts, and U-bolts, in above ground applications and not in contact with water shall be in accordance with ASTM A307, Grade A.

   b. Carbon steel nuts in above grade applications and not in contact with water shall be in accordance with ASTM A563.

   c. Steel washers shall be in accordance with ASTM F436.

   d. Carbon steel bolts greater than 1-inch in diameter shall be the 8-pitch thread series and shall be ferritic steel in accordance with ASTM A193, Grade B7. Accompanying nuts shall be in accordance with ASTM A194, Grade 2H.

5. Stainless Steel Fasteners

   a. Except as otherwise specified or shown on the Drawings, stainless steel fasteners shall be used when buried or where the material will be immersed in water, intermittently or continuously, or in moist-environment installations.

   b. Type 316 or 316N stainless steel fasteners shall be in accordance with ASTM A193 Grade B8MA or Grade B8MNA for bolting and stud material, and

ASTM A194 Grade 8MA or Grade 8MNA for nuts. Fasteners for age-hardened stainless steel shall be manufactured in accordance with ASTM F593 and F594 Type 630.

c. Stainless steel washers shall conform to ASTM F436 except that they shall be punched from steel conforming to ASTM 167 Type 316 or machined from bar stock conforming to ASTM A276 Type 316.

d. Stainless steel studs, bolts, nuts, and washers shall be stamped indicating the type of stainless steel.

E. Welding Rods

1. Welding rods for welding carbon steel shall be E6010(5P), in accordance with AWS A5.1 or A5.17 for welding carbon steel.

2. Electrodes for welding stainless steel shall be Type E316L in accordance with AWS A5.4 or AWS A5.9

3. Electrodes for welding stainless steel to carbon steel shall be Classification Number E309L or E312 in accordance with AWS A5.4 or A5.9.

4. Electrodes for welding aluminum shall be filler alloy 5356 in accordance with AWS A5.10.

F. Concrete anchors shall be in accordance with Specifications Section 03250, Concrete Anchors.

G. Anti-Galling Compound

1. The anti-galling compound to be used on threads of stainless steel fastener assemblies shall be a compound certified by ANSI/NSF or EPA, for use in potable water systems.

2. Acceptable Products:

a. Ramco TRX-Synlube, Ramco Anti-Seize

b. Husk-It, Husky Lube-O-Seal

c. TRIPAC 2000

d. OAE

2.02 FABRICATION OF MISCELLANEOUS METALWORK

A. The Contractor shall take the necessary precautions as described in ASTM A143 and ASTM A384 during fabrication of articles to be galvanized, to properly fabricate and prepare the material to prevent embrittlement, warpage, and distortion.

1. Violation of the provisions of this paragraph will be sufficient cause for rejection of the Work.

2. Steel tubing with cover plates welded at both ends or other enclosed assemblies shall have vent and drain holes drilled at locations on the assembly approved by the District Engineer. The holes shall be drilled during fabrication and before galvanizing.

B. All edges, corners, and welds shall be struck and deburred.

2.03 FABRICATION - WELDING OF CARBON STEEL

A. Except for the modifications set forth in this Section, the welding of structures or articles fabricated from carbon steel shall be in accordance with the AISC Manual of Steel Construction and AWS D1.1 as referenced therein.

B. Electroslag and electrogas welding procedures will not be permitted.

C. Allowable unit stresses for base metals and for effective areas of weld metal for application to structures shall be as shown in the AISC Manual of Steel Construction.

D. Joints to be welded by automatic machines shall be abrasive-blasted to white metal in accordance with SSPC-SP5.

E. Electrodes for shielded metal arc welding (SMAW) shall not be larger than ¼- inch for shop welding and not larger than 3/16-inch for field welding.

F. The depth of each pass shall not exceed 1/8-inch for manual welding, and the weld puddle width shall not exceed three times the electrode diameter or 3/8- inch, whichever is less.

G. Welding of pipe or tubing shall be in accordance with the recommendations of AWS D10.12.

H. Runoff tabs shall be removed by hand flame-cutting or other means as close to the edge or the finished member as practical, followed by grinding to a smooth surface contiguous with the adjacent metal.

2.04 FABRICATION - WELDING OF STAINLESS STEEL

Welding of structures or articles fabricated from stainless steel shall be in accordance with the following:

A. Welding on austenitic stainless steel shall be performed by the shielded metal arc process using direct current.

B. Electrodes for welding austenitic stainless steels shall be in accordance with AWS A5.4 Classification Number E316L. Electrodes for welding stainless steel to carbon steel shall be Classification Number E309L or E312 electrodes.

C. Weld procedures shall be qualified in accordance with AWS B2.1.

D. Welding of stainless pipe or tubing shall be in accordance with the recommended practices of AWS D10.4.

E. Stainless steel to carbon steel welds performed in the field will not require stress-relieving heat treatment provided the interpass temperature does not exceed 350°F.

F. Stress-relieving of austenitic stainless steel where deemed necessary by District Engineer, shall be performed at 750°F for 4 hours, plus an additional 30 minutes for each additional inch over ½-inch weld section thickness, or a full solution anneal at 1900°F shall be performed with rapid quench.

G. Stainless steel welds shall be deburred and ground smooth using grinding wheels of aluminum oxide. Carborundum or other carbon bearing wheels are not acceptable for use on stainless steel surfaces. Wire brushing of stainless steel surfaces shall be performed only with stainless steel brushes. Grind wheels and brushes used to clean stainless steel shall not have been used on carbon steel surfaces.

H. After shop fabrication stainless steel shall be cleaned, descaled, and passivated in accordance with ASTM A380.

2.05 SHOP FINISHES

A. Galvanizing

1. Galvanizing shall have an average weight per square foot of 2.0 ounces and not less than 1.8 ounces per square foot.

2. Except where otherwise specified, galvanizing shall be performed after fabrication, including cutting, punching, welding, and drilling, has been completed.

3. Prior to galvanizing, items shall be cleaned by abrasive blasting to white metal in accordance with SSPC-SP5.

    a. Weld flux residue, weld splatter, and minor weld defects not removed by the abrasive blasting shall be removed by mechanical means.

    b. After abrasive blasting and mechanical cleaning, items shall be fluxed and immediately hot dipped.

4. Galvanizing shall be done in the largest possible subassemblies consistent with the appearance of the completed item and with the prevention of warpage of the product.

5. Galvanizing shall be repaired in accordance with one of the methods specified in Part 3 of this Section.

6. Where galvanized light-gauge sheet goods are specified, upset edges of factory die-punched holes need not have the bare edges re-galvanized and the galvanized coating adjacent to such die-punched edges need not be repaired.

B. Aluminum

1. Aluminum shall be coated in accordance with Specifications Section 09900, Painting and Coating Systems.

2. Where specified, aluminum materials shall receive a hard anodized finish after all fabrication work (holes, bends, etc.) has been completed.

PART 3 EXECUTION

3.01 INSTALLATION

A. Installation and anchoring details for miscellaneous metal items shall be as shown on the Drawings. Details not shown shall be developed by the Contractor and indicated on the submittal shop drawings.

B. Anti-galling compound shall be used each time stainless steel fasteners are assembled or reassembled and shall be applied in the fastener threads in accordance with the manufacturer's printed recommendations.

3.02 REPAIR OF GALVANIZED SURFACES

Areas of galvanizing damaged during fabrication, shipping, erection, or any other time prior to acceptance of the Work shall be prepared and recoated by one of the following methods:

A. Parts damaged in the shop shall be removed from the site, stripped of existing coating, cleaned, and re-galvanized in accordance with ASTM A123 or A153 as applicable.

B. Field or shop repair areas shall be cleaned and recoated with a 2.0 mil coating of zinc alloy using meltable zinc-based alloy bars (hot bar process).

1. The damaged area shall be thoroughly cleaned using a wire brush, a light grinding action or mild abrasive blasting. The cleaning shall extend beyond the damaged area to lap the undamaged galvanized coating at least ½-inch.

2. Weld flux residue, and weld splatter of a size or type that cannot be removed by blast cleaning shall be removed by chipping, scaling or other mechanical means.

3. The cleaned area shall be preheated to at least 600°F but not more than 750°F. The surrounding galvanized area shall not be burned. The area to be repaired shall be wire brushed during this preheat.

4. The cleaned preheated area shall be rubbed with the repair alloy stick to deposit an evenly distributed layer of the zinc alloy.

5. The repaired area shall be wiped with a damp cloth to remove flux residue.

6. Dry –film thickness shall be verified using a magnetic or electromagnetic-type gauge, in accordance with ASTM D1186.

C. Shop or field-damaged areas shall be cleaned and recoated with a 4.0 mil minimum coating of zinc, using sprayed zinc (metalizing process).

1. Zinc wire used in repair shall contain not less than 99.98% zinc.

2. The surface to be repaired shall be blast cleaned to white metal in accordance with SSPC-SP5. The area to be blast cleaned shall extend at least ½-inch onto the surrounding sound coating area.

3. Weld flux residue and weld splatter of a size or type that cannot be removed by blast cleaning shall be removed by chipping, scaling, or other mechanical means.

4. Sprayed coating shall be applied within 2 hours after surface preparation has been completed and before any visible deterioration (flash-rust) has occurred.

5. The coating shall be applied to the clean and dry surface by metal spraying pistols fed with zinc wire or zinc powder.

6. The surface of the sprayed zinc shall be of uniform texture, free of lumps, coarse areas, and loosely adhered particles.

7. Dry film thickness shall be verified using a magnetic or electromagnetic-type, gauge, in accordance with ASTM D1186.

D. In the field, for areas where the hot bar or metalizing process methods cannot be used, and with the permission of the District Engineer, the damaged areas shall be repaired with multiple coats of an approved coating such as Rustoleum Zinc Rich Cold Galvanizing Aerosol; CRC Zinc-It; Spray-on #740 zinc-rich; Sherwin Williams #140 Zinc-Rich; OAE.

1. The damaged area shall be cleaned and recoated with an organic zinc-rich paint to a minimum dry film thickness (DFT) of 6.0-mils applied in two coats.

2. The surface to be repaired shall be blast cleaned to white metal in accordance with SSPC-SP5. The area to be blast cleaned shall extend at least ½-inch onto the surrounding sound coating area.

3. Weld flux residue and weld splatter of a size or type that cannot be removed by blast cleaning shall be removed by chipping, scaling or other mechanical means.

4. In areas where abrasive blasting cannot be used or cannot effectively clean the required area, power disk sanding or other cleaning methods shall be used, subject to the approval of the District Engineer.

5. Apply paint containing zinc dust to the prepared area as recommended by the paint manufacturer.

6. Dry film thickness shall be verified using a magnetic or electromagnetic-type gauge, in accordance with ASTM D118.

END OF SECTION 05500

SECTION 09900

PAINTING AND COATING

PART 1 GENERAL

1.01 DESCRIPTION

This section described the requirements for the preparation of surfaces and subsequent application of protective coatings. The Contractor shall furnish all labor, materials and equipment required for satisfactory completion of all items contained herein. The Contractor shall furnish all necessary safety equipment and protective clothing, as well as be responsible for proper instruction and supervision of their use.

1.02 SUBMITTALS

Contractor shall furnish submittals in accordance with the requirements of Section 1 – General Conditions. The following submittals are required:

A. Submit a chart of the manufacturer's available colors for color selection well in advance of painting operation.

B. Submit manufacturer's data sheets showing the following information:

1. Recommended surface preparation.

2. Minimum and maximum recommended dry-film thicknesses per coat for prime, intermediate, and finish coats.

3. Percent solids by volume.

4. Recommended thinners.

5. Statement verifying that the selected prime coat is recommended by the manufacturer for use with the selected intermediate and finish coats.

6. Application instructions including recommended application, equipment, humidity, and temperature limitations.

7. Curing requirements and instructions.

C. Submit certification that all coatings conform to applicable local Air Quality Management District rules and regulations for products and application.

PART 2 MATERIALS

2.01 GENERAL

A. All materials shall be those of current manufacture and shall meet all applicable regulations for the application and intended service. All coats of any particular coating system shall be of the same manufacturer and shall be approved by the manufacturer for the intended service. In the event that a product specified herein is no longer manufactured or does not meet current regulations, the Contractor shall provide a substitute, currently manufactured product of at least equal performance which meets all applicable regulations, subject to the District Engineer's approval, at no additional cost.

B. All materials shall be delivered to the Project Site in their original, unopened containers bearing the manufacturer's name, brand, and batch number. Standard products of manufacturers other than those specified will be accepted when it is proved to the satisfaction of the District Engineer they are equal in composition, durability, usefulness and convenience for the purpose intended.

Ameron Corrosion Control Division, Brea, CA
ICI Devoe Coatings, Strongsville, OH
Tnemec Company, Inc., Kansas City, MO, 64141

C. All surfaces to be coated or painted shall be in the proper condition to receive the material specified before any coating or painting is done. No more sandblasting or surface preparation than can be coated or painted in a normal working day will be permitted. All sharp edges, burrs, and weld spatter shall be removed. All concrete and masonry surfaces shall cure 30 days prior to coating or painting.

D. Surface preparation, prime coatings, and finish coats for the various systems are specified herein. Unless otherwise noted, all intermediate and finish coats shall be of contrasting colors. It is the intent that the coating alternates specified herein serve as a general guide for the type of coating desired.

2.02 METAL, INTERIOR AND EXTERIOR, NORMAL EXPOSURE

A. General: The Contractor shall paint all exposed steelwork, non-galvanized handrails, exposed pipework, fittings, all mechanical equipment, pumps, motors, doors, door frames and window sash with this coating system. All metalwork previously given a shop prime coat approved by the District Engineer shall be touched up as required in the field with an approved coating.

B. Surface Preparation: All exterior metal surfaces which are to be painted shall be commercial blast cleaned per Specification SP-6 (commercial blast cleaning) except as otherwise specified, in locations where sandblasting would damage previously coated surfaces and installed equipment, and in locations where dry sandblasting is prohibited. The above locations in which SP-6 commercial sandblasting is not possible shall be given a SP-3 power tool cleaning. This sandblasting shall be done not more than 8 hours ahead of the painting, subject to humidity and weather conditions between the time of sandblasting and painting operations. If any rusting or discoloration of sandblasted surfaces occurs

before painting, such rusting or discoloration shall be removed by additional sandblasting. Sandblasted surfaces shall not be left overnight before painting.

C. Coating:

1. Prime coat or spot prime coat: Tnemec Series 18 Enviro-Prime applied at 2.0 to 3.5 mils DFT.

2. Intermediate Coat: Tnemec Series 1028 Tufcryl Gloss Acrylic applied at 2.0 to 2.5 mils DFT.

3. Finish Coat: Tnemec Series 1028 Tufcryl Gloss Acrylic applied at 2.0 to 2.5 mils DFT.

4. Total dry-film thickness of the complete system shall be 6.0 to 8.5 mils DFT.

2.03 METAL, SUBMERGED OR INTERMITTENTLY SUBMERGED

A. General: All submerged metalwork, gates, equipment, valves, exposed pipework and all other metalwork within areas which will be submerged, except as noted hereinafter, shall be painted with this coating system.

B. Surface Preparation: All metal surfaces shall be field sandblasted according to SSPC-SP-10 (near white blast cleaning).

C. Coating:

1. Coating (Potable water):
Prime coat: Tnemec Series V140 or V140F Pota-Pox Plus applied at 4.0 to 6.0 mils DFT.
Intermediate coat: Tnemec Series V140 or V140F Pota-Pox Plus applied at 4 to 6 mils DFT.
Finish coat: Tnemec Series V140 or V140F Pota-Pox Plus applied at 4 to 6 mils DFT.
Total dry-film thickness of the complete system shall be 12.0 to 18.0 mils.

2. Coating (Non-potable):
Primer: Tnemec Series V69 Epoxoline II applied at 4 to 6 mils DFT.
Intermediate coat: Tnemec Series V69 Epoxoline II applied at 4 to 6 mils DFT.
Finish coat: Tnemec Series V69 Epoxoline II applied at 4 to 6 mils DFT.
Total dry-film thickness of the complete system shall be a 12.0 to 18.0 mils DFT.

NOTE: Tnemec Series V140 or V140F can also be used for Non-Potable system.

2.04 METAL, SEVERE EXPOSURE TO MOISTURE OR CHEMICAL FUMES

A. Surface Preparation: All metal surfaces shall be field sandblasted according to SSPC-SP-10 (near white blast cleaning).

B. Coating:

1. Exterior Coating:
   Shop prime coat: Tnemec Series 90-97 Tneme-Zinc applied at 2.5 to 3.5 mils DFT.
   Touch-up (Field): Tnemec Series 90-97 Tneme-Zinc applied at 2.5 to 3.5 mils DFT.
   Intermediate Coat: Tnemec Series V69 Epoxoline II applied at 3.0 to 5.0 mils DFT.
   Finish Coat: Tnemec Series 1075 Endura-Shield II @ 2.0 to 3.0 mils DFT.

2. Interior Coating:
   Shop prime coat: Tnemec Series 90-97 Tneme-Zinc applied at 2.5 to 3.5 mils DFT.
   Touch-up (Field): Tnemec Series 90-97 Tneme-Zinc applied at 2.5 to 3.5 mils DFT.
   Intermediate Coat: Tnemec Series V69 Epoxoline II applied at 4.0 to 6.0 mils DFT.

3. Finish Coat: Tnemec Series V69 Epoxoline II applied at 4.0 to 6.0 mils DFT.

2.05 METAL, HIGH-TEMPERATURE EXPOSURE

A. General: Engine mufflers, exhaust systems and other metal surfaces subjected to high temperatures shall be coated with this system.

B. Surface Preparation: Surface shall be field sandblasted in accordance with SSPC-SP-10 (near white blast cleaning).

C. Coating (Tnemec Alternate): One coat of Tnemec Series 90-96 Tneme-Zinc to a total dry-film thickness of 2.5 to 3.5 mils.

D. Coating (ICI Devoe Coatings Alternate): One coat of Catha-Coat 304V Zinc to a dry-film thickness of 2 to 4 mils.

2.06 METAL, GALVANIZED, ALUMINUM, COPPER, OR BRASS

A. Surface Preparation: Surfaces shall be solvent cleaned in accordance with SSPC-SP-1 (solvent cleaning) and SSPC-SP- (Brush off Blast cleaning). Next, apply recommended coating or paint for the particular surface to be coated.

B. Coating Interior Exposed:
   Prime coat: Primer: Tnemec Series V69 Epoxoline II applied at 2 to 3 mils DFT.
   Finish coat: Tnemec Series V69 Epoxoline II applied at 2 to 3 mils DFT.
   Total try-film thickness of the complete system shall be 4.0 to 6.0 mils.

C. Coating Exterior Exposed:
   Prime coat: Primer: Tnemec Series V69 Epoxoline II applied at 2 to 3 mils DFT.
   Finish coat: Tnemec Series 1075 Endura-Shield II applied at 2 to 3 mils DFT.
   Total try-film thickness of the complete system shall be 4.0 to 6.0 mils.

D. Coating (Sinclair Alternate) 7113 Wash Primer applied at ½ mil dry-film thickness.

2.07 METAL, BURIED

A. General: The Contractor shall coat all buried metal which includes valves, bolts, nuts, structural steel and fittings. It does not include steel storage reservoirs.

B. All buried flanges, fittings, and nuts and bolts shall be wrapped per AWWA C-217 and wrapped with polyethylene encasement per AWWA C – 105. Nuts and Bolts shall be individually wax taped per FPUD Standard Drawing CP-9 notes. Buried Valves shall be wrapped with polyethylene encasement per AWWA C-105.

C. Surface Preparation: Sandblast to SSPC-SP-6 (commercial blast cleaning)

D. Coating (Tnemec Alternate): Prime Coat: Tnemec Series 46H-413 Hi-Build Tneme-Tar applied at 8.0 to 10.0 mils DFT. Finish Coat: Tnemec Series 46H-413 Hi-Build Tneme-Tar applied at 8.0 to 10.0 mils DFT. Total dry-film thickness shall be 16.0 to 20 mils.

2.08 MASONRY, EXTERIOR, NORMAL EXPOSURE

A. General: All exterior masonry surfaces subject to normal exposure shall be painted with this system.

B. Surface Preparation: Surfaces shall be free of dirt, dust, grease, or other deleterious matter before coating. All cracks and voids shall be filled with a suitable caulking material compatible with the specified coating.

C. Coating (Tnemec Alternate): Prime Coat: Tnemec Series 180 W.B. Tneme-Crete, 4.0 to 6.0 mils DFT. Finish Coat: Tnemec Series 180 W.B. Tneme-Crete, 4.0 to 6.0 mils DFT. Total dry-film thickness shall be 8 to 12 mils.

D. Coating (ICI Devoe Coatings Alternate): Two (2) coats of Devflex 4020 Acrylic, 2.5 to 3.5 mils dry-film thickness, each. Total dry-film thickness shall be 6 mils minimum.

2. 09 MASONRY, INTERIOR

A. Surface Preparation: For concrete surfaces, surfaces to be coated must be sandblasted according to SSPC-SP-7 (brush-off blast cleaning) with 60-80 mesh sand and air pressure 50-60 psi to remove all cement glaze and residue of form release agents and provide a uniform surface profile of approximately 1 mil. Fill voids, holes, and pits with Tnemec Series 104 H.S. Epoxy sprayed and backrolled to create a void-free surface or (Devoe Coating) Tru-Glaze 4015 Epoxy applied as required. Vacuum clean or air blast surface prior to coating. Surfaces shall cure a minimum of 28 days prior to coating.

B. Interior Coating (Tnemec Alternate): CMU Coating System: Block Filler / Prime Coat: Tnemec Series 130 Envirofill applied at 60 to 115 sq ft/gal to create a void-free surface. Intermediate coat: Tnemec Series V69 Epoxoline II applied at 4 to 6 mils DFT. Finish coat: Tnemec Series V69 Epoxoline II applied at 4 to 6 mils DFT. Total dry-film thickness of the complete system shall be a minimum of 8-12 mils not including block filler.

C. Concrete System: Filler Coat: Tnemec Series 218 Mortar-Clad as required to fill bugholes and cracks in concrete. Intermediate coat: Tnemec Series V69 Epoxoline II applied at 4 to 6 mils DFT. Finish coat: Tnemec Series V69 Epoxoline II applied at 4 to 6 mils DFT. Total dry-film thickness of the complete system shall be a minimum of 8-12 mils not including filler.

2.10 MASONRY, SEVERE EXPOSURE

A. General: This system is for interior and exterior masonry surfaces subject to severe exposure or chemical attack.

B. Surface Preparation: Surfaces to be coated must be sandblasted according to SSPC-SP-7 (brush-off blast cleaning) with 60-80 mesh sand and air pressure of 50-60 psi to remove all cement glaze and residue of form release agents and provide a uniform surface profile of approximately 1 mil. Fill voids, holes, and pits with Tnemec Series 104 H.S. Epoxy sprayed applied as required. Vacuum clean or air blast surface prior to coating. Surfaces shall cure a minimum of 28 days prior to coating.

C. Coating (Tnemec Alternate): CMU Coating System: Block Filler / Prime Coat: Tnemec Series 130 Envirofill applied at 60 to 115 sq ft/gal to create a void-free surface. Intermediate coat: Tnemec Series 104 H.S. Epoxy applied at 6 to 8 mils DFT. Finish coat: Tnemec Series 104 H.S. Epoxy applied at 6 to 8 mils DFT. Total dry-film thickness of the complete system shall be a minimum of 12-16 mils not including block filler.

D. Concrete System: Filler Coat: Tnemec Series 218 Mortar-Clad as required to fill bug holes and cracks in concrete. Intermediate coat: Tnemec Series 104 H.S. Epoxy applied at 6 to 8 mils DFT. Finish coat: Tnemec Series 104 H.S. Epoxy applied at 6 to 8 mils DFT. Total dry-film thickness of the complete system shall be a minimum of 12-16 mils not including filler.

2.11 CONCRETE FLOORS

A. General: Includes specified concrete floors subject to moisture and pedestrian traffic.

B. Surface Preparation: Surfaces to be coated must be sandblasted in accordance with SSPC-SP-7 (brush-off blast cleaning) with 60-80 mesh sand and air pressure of 50-60 psi to remove all cement glaze and residue or other agents and provide a uniform surface profile of approximately 1 mil.

C. Coating (Tnemec Alternate): Floor Coating: Prime Coat: Series 201 Epoxoprime applied at 4.0 to 6.0 mils DFT. Intermediate Coat: Tnemec Series 280 Tneme-Glaze at 6 to 8 mils DFT. Finish Coat: Tnemec Series 280 Tneme-Glaze at 6 to 8 mils DFT. Total dry-film thickness shall be 16.0 to 22 mils.

2.12 WOODWORK - INTERIOR AND EXTERIOR

A. General: The Contractor shall paint all interior and exterior wood including, but not limited to, doors, frames, panels, sash and trim.

B. Surface Preparation: Surfaces shall be clean, dry, and free of all contaminants. All surfaces shall be sanded smooth. Knots, pitch pockets, and other bleed points shall be sealed with a shellac-based sealer after areas are scraped clean and sanded. Holes and imperfections shall be spot-primed, filled with plastic wood filler, and sanded smooth. All surfaces shall be dusted clean prior to coating. Moisture content shall be tested using an electronic moisture meter and shall not exceed 15%.

C. Coating (Tnemec Alternate): Interior & Exterior Coating: Prime coat: Tnemec Series 151-1051 Elastic-grip FC applied at 1 mil DFT. Intermediate Coat: Tnemec Series 1029 Tufcryl Semi-Gloss applied at 1.5 to 2.0 mils DFT. Finish Coat: Tnemec Series 1029 Tufcryl Semi-Gloss applied at 1.5 to 2.0 mils DFT. Total dry-film thickness of the complete system shall be 4.0 to 5.0 mils DFT.

2.13 PLASTER, DRYWALLS - INTERIOR

A. Surface Preparation: Surfaces shall be free of dirt, dust, grease, or other deleterious matter before coating. All cracks and voids shall be filled with a suitable spackling material compatible with the specified coating.

B. Coating (Tnemec Alternate): Coating: Prime coat: Tnemec Series 51-792 Sealer applied at 1 to 2 mils dry-film thickness. Finish coats(2): Tnemec Series 6 Tneme-Cryl applied at 2 to 3 mils dry-film thickness, each. Total dry-film thickness shall be 5.0 to 8 mils.

PART 3 EXECUTION

3.01 GENERAL

A. The Contractor shall arrange with the District Engineer so that all surface preparation may be inspected and approved prior to the application of any coatings.

B. The Contractor is hereby notified that the District Engineer will inspect the Work prior to the expiration of the warranty period and all defects in workmanship and material shall be repaired by the Contractor, at his own expense.

3.02 WORKMANSHIP

A. It is the intent of the Specifications that finishes shall be provided which meet standards for best grades of painting. Drop cloths shall be placed where required to protect floors, surfaces and equipment from spatter and dropping, not to receive paint or coatings.

B. The Contractor shall take all necessary precautions to protect all adjacent Work and all surrounding property and improvements from any damage whatsoever as a result of the painting and coating operation.

C. Only good, clean brushes and equipment shall be used and all brushes, buckets, and spraying equipment shall be cleaned immediately at the end of each painting period.

D. Each coat of paint shall be of the consistency as supplied by the manufacturer, or thinned, if necessary, and applied in accordance with manufacturer's instructions. Each coat shall be well brushed, rolled or sprayed to obtain a uniform and evenly applied finish. Work shall be free from "runs", "bridges", "shiners", or other imperfections due to faulty intervals. Particular care shall be taken to obtain a uniform unbroken coating over all bolts, threads, nuts, welds, edges and corners. Paint shall not be applied in extreme heat, in dust or smoke laden air, or in damp or humid weather, unless written permission of the District Engineer is obtained.

E. If paint is applied by spray, the air pressure used shall be within the ranges recommended by both the paint and spray equipment manufacturers. Spray painting shall be conducted under controlled conditions and the Contractor shall be fully responsible for any damage occurring from spray painting.

F. Care shall be exercised not to damage adjacent Work during sandblasting operations. Stainless steel need not be sandblasted. Blasted surfaces shall not be left overnight before coating. All dust shall be removed from the surface following sandblasting.

3.03 APPLICATION PROCEDURES

A. Surfaces to be Coated: All surfaces of materials furnished and constructed are to be painted or coated per the Specifications except as indicated below.

B. Surfaces Not To Be Coated: The following surfaces shall not be coated unless otherwise noted on the Plans and shall be fully protected when adjacent areas are painted:

Aluminum grating	Grease fittings	Nameplates on machinery
Aluminum surfaces	Hardware	Pipe interior*
Bearings	Lighting fixtures	Shafts
Brass and copper tubing, submerged*	Machined surfaces	Stainless steel
Buried pipe	Metal letters	Switch plates
Couplings	Mortar-coated pipe & fittings	

* unless specifically required on the Plans or elsewhere in the Specifications

C. Protection of Surfaces Not To Be Coated: Surfaces not intended to be painted shall be removed, masked, or otherwise protected. Drop cloths shall be provided to prevent paint materials from falling on or marring adjacent surfaces. Working parts of mechanical and electrical equipment shall be protected from damage during surface preparation and painting process. Openings in motors shall be safely masked to prevent paint and other materials from entering the motors. All masking materials shall be completely removed and surfaces cleaned at completion of painting operations.

D. Weather Conditions:

1. Paint shall not be applied in the rain, wind, snow, mist, and fog or when steel or metal surface temperatures are less than 5°F above the dew point.
2. Paint shall not be applied when the relative humidity is above 80%, the air temperature is above 90°F, or the temperature of metal to be painted is above 125°F.

3. Alkyd, chlorinated rubber, inorganic zinc, silicone aluminum, or silicone acrylic paints shall not be applied if air or surface temperature is below 50°F or expected to be below 50°F within 24 hours.

4. Epoxy, coal tar epoxy, acrylic latex, and polyurethane paints shall not be applied on an exterior or interior surface if air or surface temperature is below 50°F or expected to drop below 50°F within 24 hours.

3.04 SURFACE PREPARATION

A. General: Sandblast or prepare only as much surface area as can be coated in one day. All sharp edges, burrs, and weld spatter shall be removed. Epoxy-coated pipe that has been factory coated shall not be sandblasted.

B. SSPC Specifications:

1. Wherever the words "solvent cleaning", "hand tool cleaning", "wire brushing", or "blast cleaning" or similar words are used in the Specifications or in paint manufacturer's specifications, they shall be understood to refer to the applicable SSPC (Steel Structures Paint Council, Surfaces Preparation Specifications, ANSI A159.1) Specifications listed below:

SP-1	Solvent Cleaning	SP-6	Commercial Blast Cleaning
SP-2	Hand Tool Cleaning	SP-7	Brush-Off Blast Cleaning
SP-3	Power Tool Cleaning	SP-8	Pickling
SP-5	White Metal Blast Cleaning	SP-10	Near White Blast Cleaning

2. Oil and grease shall be removed from aluminum and copper surfaces in accordance with SSPC SP-1 using clean cloths and cleaning solvents.

3. Weld spatter and weld slag shall be removed from metal surfaces. Rough welds, beads, peaked corners, and sharp edges including erection lugs shall be ground smoothly in accordance with SSPC SP-2 and SSPC SP-3.

4. Welds shall be neutralized with a chemical solvent that is compatible with the specified coating materials using clean cloths and chemical solvent.

C. Abrasive Blast Cleaning:

1. Dry abrasive blast cleaning shall be used for metal surfaces. Do not recycle or reuse contaminated blast particles.

2. Dry clean surfaces to be coated by dusting, sweeping, and vacuuming to remove residue from blasting. Apply the specified primer or touch-up coating within the period of an 8-hour working day. Do not apply coating over damp or moist surfaces. Reclean prior to application of primer or touch-up coating any blast cleaned surface not coated within said 8-hour period.

3. Prevent damage to adjacent coatings during blast cleaning. Schedule blast cleaning and coating such that dust, dirt, blast particles, old coatings, rust, mill scale, etc., will not damage or fall upon wet or newly coated surfaces.

3.05 PROCEDURES FOR THE APPLICATION OF COATINGS

A. The recommendations of the coating manufacturer shall be followed, including the selection of spray equipment, brushes, rollers, cleaners, thinners, mixing, drying time, temperature and humidity of application, and safety precautions.

B. Coating materials shall be kept at a uniform consistency during application. Each coating shall be applied evenly, free of brush marks, sags, runs, and other evidence of poor workmanship. A different shade or tint shall be used on succeeding coating applications to indicate coverage where possible. Finished surfaces shall be free from defects or blemishes.

C. Only thinners recommended by the coating manufacturer shall be used. If thinning is allowed, do not exceed the maximum allowable amount of thinner per gallon of coating material.

D. Apply a brush coat of primer on welds, sharp edges, nuts, bolts, and irregular surfaces prior to the application of the primer and finish coat. The brush coat shall be done prior to and in conjunction with the spray coat application. Apply the spray coat over the brush coat.

E. Apply primer immediately after blast cleaning and before any surface rusting occurs, or any dust, dirt, or any foreign matter has accumulated. Reclean surfaces by blast cleaning that have surface colored or become moist prior to coating application.

1. Paint Mixing: Multiple-component coatings shall be prepared using all the contents of each component container as packaged by the paint manufacturer. Partial batches shall not be used. Multiple-component coatings that have been mixed beyond their pot life shall not be used. Small quantity kits for touch-up painting and for painting other small areas shall be provided. Only the components specified and furnished by the paint manufacturer shall be mixed. For reasons of color or otherwise, additional components shall not be intermixed, even within the same generic type of coating.

2. Field Touch Up of Shop-Applied Prime Coats: Organic Zinc Primer: Surfaces that are shop primed with zinc rich primers shall receive a field touch up of organic zinc primer to cover all scratches or abraded areas. Organic zinc coating system shall have a minimum volume solids of 62% and a minimum zinc dust content of 83% by weight in the dried film. Coating shall be of urethane type and shall be manufactured by the prime coat and finish coat manufacturer.

3. Other Primers: Surfaces that are shop primed with other than organic zinc primer shall receive a field touch up of the same primer used in the original prime coat.

3.06 DRY-FILM THICKNESS TESTING AND REPAIR

A. Special Instructions to the Contractor: The Contractor shall furnish to the District at no charge for use during execution of the Work, necessary dry-film thickness gauge and electrical flaw detection equipment. The Contractor shall perform the holiday (pinholes) inspection in the presence of the District Engineer, and the Contractor shall monitor wet film measurements throughout the application of each coat of coating.

B. Coating Thickness Testing: Coating thickness specified for steel surfaces shall be measured with a magnetic-type dry-film thickness gauge. Dry-film thickness gauge shall be provided as manufactured by Mikrotest or Elcometer. Each coat shall be checked for the correct dry-film thickness. Measurement shall not be made until a minimum of eight hours after application of the coating. Non-magnetic surfaces shall be checked for coating thickness by micrometer measurement of cut and removed coupons. Contractor shall repair coating at all locations where coupons are removed.

C. Holiday Testing: The finish coat (except zinc primer and galvanizing) shall be tested by the Contractor for holidays and discontinuities with an electrical holiday detector of the low-voltage, wet-sponge type. All testing shall be done in the presence of the District Engineer and conducted per manufacturer's written recommendations. All Holiday testing shall be in conformance with NACE RP 0188-88 / RP 0490.

D. Repair: If the item has an improper finish, color, insufficient film thickness, or holidays, the surface shall be cleaned and top-coated with the specified paint material to obtain the specified color and coverage. Visible areas of chipped, peeled, or abraded paint shall be hand or power-sanded, feathering the edges. The areas shall then be primed and finish coated in accordance with the Specifications. Work shall be free of runs, bridges, shiners, laps, or other imperfections.

3.07 CLEANUP

Upon completion of all painting and coating Work, the Contractor shall remove all surplus materials and rubbish. The Contractor shall repair all damage and shall leave the premises in a clean and orderly condition.

END OF SECTION

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SECTION 13110

CORROSION CONTROL FOR BURIED PIPING

PART 1 GENERAL

1.01 SCOPE

This specification section addresses the materials, installation and testing for basic corrosion control and monitoring facilities required on most buried metallic piping. The corrosion control facilities include in this specification section are: corrosion test stations, joint bonding, insulating flange kits, casing test stations, wire and cable, alumino-thermic welds, and simple sacrificial anode installations. Large piping projects or projects requiring large sacrificial anode or impressed current cathodic protection systems will require more detailed drawings and specifications.

1.02 REFERENCE STANDARDS

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designations only.

ANSI B16.21.92	Nonmetallic Flat Gaskets for Pipe Flanges
ASTM C94-81	Ready –Mix Concrete
ASTM D1248-89	Polyethylene Plastics Molding and Extrusion Materials
ASTM D2220-80	Polyvinylchloride Insulation for Wire and Cable, 75º Operation
AWWA C217-90	Cold-Applied Petrolatum Tape and Petroleum Wax Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Buried Steel Water Pipelines
NACE RP0169-96	Recommended Practice, Control of External Corrosion on Underground or Submerged Metallic Piping Systems
NACE RP0286-97	Electrical Isolation of Cathodically Protected Pipelines
NEMA LI-1-1983	Industrial Laminate Thermosetting Products
MIL-C-18480B	Coating Compound, Bituminous, Solvent, Coal Tar Base
UL 83-80	Thermoplastic-Insulated Wires
UL 486-76	Wire Connectors and Soldering Lugs for Use with Copper Conductors

1.03 RELATED WORK SPECIFIED ELSEWHERE

FPUD	Standard Drawings CP-1 through CP-17
Project Specific	Cathodic Protection Specifications and Drawings
FPUD	Standard Drawings
FPUD	Standard Specifications
Section 02223	Trenching, Backfilling, and Compacting
Section 03300	Cast-in-Place Concrete
Section 15056	Ductile Iron Pipe and Fittings
Section 15076	CML&C Steel Pipe

1.04 SUBMITTALS

A. Submit shop drawings in accordance with FPUD Standard Specifications.

B. Submit five (5) copies of manufacturer's catalog data and descriptive literature for all material items listed below and included in the project. Show dimensions and materials of construction by specification reference and grade where applicable.

1.05 DUCTILE IRON PIPE ENCASEMENT

Unless otherwise specified all ductile iron pipe shall be fully encased in 8 mil (0.008 inches) polyethylene sheet material in accordance with AWWA C105 Method A and STD SPEC 15056. The plastic encasement shall be installed without pinholes or tears and shall be fully protected from damage during backfilling. All pipe sections shall be fully inspected by the District Engineer before the pipe is backfilled.

1.06 BURIED VALVES, FLANGES AND COUPLINGS

A. Area with groundwater or perched water

Wax Tape Coating

1. All buried, non-mortar coated piping surfaces such as valves, couplings, adapters, flanges or bare pipe shall be wrapped with petrolatum wax tape coating in accordance with AWWA C-217 and this specification

2. The fittings and bolts surfaces shall be primed with a blend of petrolatum, plasticizer, insert fillers, and corrosion inhibitor having a paste-like consistency.

3. Filling covering material shall be a synthetic felt tape, saturated with a blend of petrolatum plasticizers, and corrosion inhibitors that is easily formable over irregular surfaces.

4. The primed and wax-tape wrapped fitting shall be wrapped with plastic tape covering consisting of 1.5 mil, polyvinylidene chloride or metallocene resin material. The tape shall have high dielectric strength, be stretchable and be able to conform well to irregular shapes.

B. Areas with no groundwater or perched water

Unless otherwise specified all ductile iron pipe shall be fully encased in 8 mil (0.008 inches) polyethylene sheet material in accordance with AWWA C105 Method A and Standard Specifications Section 15056. The plastic encasement shall be installed without pinholes or tears and shall be fully protected from damage during backfilling. All pipe sections shall be fully inspected by the District Engineer before the pipe is backfilled.

PART 2 MATERIALS

2.01 INSULATING FLANGE KITS

A. General: Insulating flange kits shall consist of Type E, full-face gaskets, insulating sleeves and double washers (steel and dielectric) on each end. All insulating material shall be of the type designated by the manufacturer as suitable for the operating temperature and pressure of the service.

B. Gaskets: Insulating gaskets shall be dielectric neoprene-faced phenolic. Note that the sealing surfaces of both flanges must be compatible with the gasket.

C. Sleeves: Use full-length sleeves except for installation on threaded studs where half-length sleeves are required. For installation on threaded bolts, i.e., at butterfly valve flange bonnets and bases, the sleeves shall be half-length. Use 1/32-inch thick G10 epoxy glass tube material as per NEMA LI-1 unless directed otherwise by the District.

D. Washers: Insulating washers shall be 1/8-inch thick G10 epoxy glass sheet material per NEMA LI-1.

E. Steel Washers: Steel washers shall be 1/8-inch thick cadmium plated or zinc plated carbon steel.

2.02 PLASTIC WARNING TAPE

Plastic warning tape for all horizontal cable trench runs shall be a minimum of 4 mils thick and 6-inches wide, inert plastic film designed for prolonged use underground. The tape shall have the words "Caution: Cathodic Protection Cable Below" or similar, clearly visible along its entire length.

2.02 MORTAR

Mortar used to repair concrete coated pipe after attachment of bond or pipe test lead wires shall be the fast drying, non-shrinkable type.

2.03 BARRIER POSTS

Where indicated protective barrier post shall be 6-inch SCH 40 steel pipe concrete filled. Pipe height, 3-feet by 3-inches, embedded depth 4-feet by 3-inches in a concrete footing. Paint OSHA safety yellow epoxy or as indicated.

PART 3 EXECUTION

3.01 GENERAL

Except as directed differently below, the installation of corrosion control and monitoring facilities shall conform to NACE Publication RP-0169 (Revised 1996) - Recommended Practice, Control of External Corrosion on Underground and Submerged Metallic Piping Systems and NACE RP0286 Electrical Isolation of Cathodically Protected Pipelines. The installation of impressed current cathodic protection facilities and large sacrificial anode systems is not included in this document.

3.02 TEST BOXES

A. At-Grade Test Boxes:

1. Location: The at-grade test boxes shall be installed directly over the pipeline if possible. If the pipeline is in a paved roadway install behind the curb and out of traffic lanes. Test boxes can be embedded in the sidewalk just beyond the curb or placed in a concrete pad in the planter strip or just beyond the sidewalk. The District Engineer shall approve test station locations.

2. Installation: Mount test box flush with pavement or 1-inch higher than grade in grass or landscaped areas with the concrete pad domed to make a smooth transition to grade at the perimeter of the pad. The bottom of the box shall be native soil. Do not place rock, gravel or cement inside the box. All wires shall be properly identified with brass tags and cut off such that there is approximately 18-inches of slack wire above finish grade and coiled inside the test box. Keep the inside of the test box clear of all debris and other foreign material.

3. Wire Identification: Brass identification tags shall be securely attached to each of the wires in the test box. Tags shall be stamped in ¼-inch characters with FPUD and the size-material-service of the pipe to which the test leads are attached. For example FPUD 18”-STL-PW. Brass tags on wires in insulating flange test boxes shall be stamped with the additional identification of “N”, “S”, “E”, or “W” for North, South, East or West to indicate on which side of the insulating flange the wires are attached. Attach tags with bare No. 14 copper wire.

4. Concrete Pad: In unpaved areas the test box shall be mounted in a reinforced concrete pad 26-inches square by 4-inches deep constructed of ASTM C94 Ready-Mix concrete. Rebar shall be No. 4 steel placed as shown in the drawings.

5. Marker Posts: Redwood marker posts are required wherever at-grade anode test boxes are utilized in a remote area. Paint the post with two (2) coats of white epoxy. Locate marker post within 6-inches of the test box or as directed by the District Engineer. On the side facing of the at-grade test box, stencil on the post in 2-inch high black letters the words “CP TEST”.

B. Post Mounted Test Boxes:

1. Location: locate redwood post directly above the pipeline, if possible, but not in a roadway or in a location that clearly obstructs existing access or is particularly susceptible to damage. The District Engineer shall approve test station locations.

2. Post and Footing: Excavate a 12-inch diameter by 20-inch deep hole. Center the post and test box in the hole and fill the hole with concrete. The post shall be true vertical. The concrete shall be class C per standard spec section 03000. Dome concrete slightly to prevent ponding water next to wood post.

3. Test Box and Conduit: Connect 2-inch galvanized conduit to the test box enclosure with a threaded flange and collar connection. Attach test box to the redwood post using mounting brackets and threaded fasteners or wood screws through the back of the test box. Attach conduit to the post with conduit clamps and wood screws if necessary. Insert all test leads in the galvanized conduit and run into test box prior to setting the post in concrete.

4. Wire Identification: Brass identification tags shall be installed and marked per paragraph 3.02.A.3.

3.03 INSULATING FLANGE KITS

A. Flange Kits: Insulating kits shall be installed as shown on drawings and as recommended by the manufacturer. Moisture, soil, or other foreign matter must be carefully prevented from contacting any portion of the mating surfaces prior to installing insulator gasket. If moisture, soil, or other foreign matter contacts any portion of these surfaces, the entire joint shall be disassembled, cleaned with a suitable solvent and dried prior to reassembly.

B. Spool Assembly: All direct buried insulating kits, greater than 20-inches in diameter, shall be pre-installed and tested on the pipe spool prior to installing the spool in the ditch. If possible, all smaller size direct buried insulating kits shall be similarly pre-installed and tested.

C. Handling of Gasket: Care shall be taken to prevent any excessive bending or flexing of the gasket. Creased or damaged gaskets shall be rejected and removed from the job site.

D. Alignment: Alignment pins shall be used to properly align the flange and gasket.

E. Bolt Tightening: The manufacturer's recommended bolt-tightening sequence shall be followed. Bolt insulating sleeves shall be centered within the insulation washers so that the insulating sleeve is not compressed and damaged.

F. Testing: All insulating flanges must be tested by a qualified Corrosion Technician or Engineer and accepted by the District Engineer. All buried insulating flanges must be tested prior to wax tape wrap coating and backfilling. The assembled flange shall be tested as described below.

G. Wax Tape Coating: After testing and the District Engineer's acceptance, the insulating flange shall be fully wrapped with petrolatum wax tape as indicated in this specification section.

3.04 SUPPLEMENTARY INTERIOR LINING AT INSULATING FLANGES

A. General: Supplementary linings are required **only** where called out in the drawings or Project Design Documents. It is the contractor's responsibility to determine and verify which insulating flanges require supplementary internal lining.

B. Extent of lining: the interior of the pipeline shall be lined with a supplementary epoxy lining for a distance of two (2) pipe diameters in each direction away from an insulating flange. At an insulated flange on a valve, the supplementary lining shall be applied (for a distance of two pipe diameters) only to the pipe directly adjacent to the insulating flange.

C. Surface Preparation: The surface preparation of the mortar lining shall consist of wire brushing (hand or power) or water blasting to remove the latence and all loose mortar to provide a clean abraded surface for adhesion of the lining. The surface shall be clean and free of dust and standing water but not necessarily dry.

D. Mixing: The two-part epoxy paint shall be thoroughly mixed per the manufacturer's recommendations but at a minimum of two (2) minutes by hand or with a mechanical mixer before being applied by brush.

E. Pot Life: A typical pot life is 30 minutes. The lining material shall not be applied after its useful pot life.

F. Application: Application of undiluted lining material shall be by spray, roller or brush until a maximum coating thickness of 20 mils is achieved. Each ensuing coat shall be applied before the previous coat fully cures, usually within 3 to 6 hours. Typically, this material is applied at the rate of 140 square feet per gallon. This would ordinarily produce the required coating with a total of two (2) coats. However, the 20-mil minimum thickness shall be satisfied regardless of the number of applications necessary to achieve it.

G. Inspection: Each pipe spool to which the supplementary lining is applied must be inspected and accepted by the District Engineer prior to assembly.

PART 4 SYSTEM TESTING

4.01 WAX TAPE COATING AND POLYETHYLE

A. Responsibility: The District Engineer shall inspect all completed wax tape and polyethylene wrapping for compliance with these specifications prior to backfilling.

B. Test Method: Inspection shall be visual.

C. Wax Tape Acceptance: Wax tape applications shall be accepted if: the application conforms with this specification; there are no voids or gaps under the wax tape; stud-ends, nuts, couplings rods and all irregular surfaces are individually wrapped such that there is complete coverage with the petrolatum material; the outer wrap is complete and tightly adhering to the wax tape; and the application is done in a good workman-like manner.

D. Supplementary Lining Acceptance: Internal supplementary linings must cover the specified length of pipe and must be well bonded to the substrate and free of voids or damage.

4.02 DEFICIENCIES

Deficiencies: Any deficiencies or omissions in materials or workmanship found by these tests shall be rectified by the Contractor at his expense. Deficiencies shall include but are not limited to: broken or missing test leads; improper or unclean wire trench backfill; inadequate pipeline continuity; shorted or partially shorted insulators or casings; lack of 18-inch slack wire in at-grade test boxes; improperly mounted or located test boxes; improper wire identification; poorly applied wax tape or supplementary lining; and other deficiencies associated with the workmanship, installation and non-functioning equipment.

END OF SECTION

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SECTION 15000

GENERAL PIPING SYSTEM AND APPURTENANCES

PART 1 GENERAL

1.01 DESCRIPTION

This section describes the requirements and procedures for piping systems (pressure pipe and gravity sewer pipe) and appurtenances that apply to a number of other complimentary Specification Sections. The items are listed in this section to avoid repetition in sections elsewhere. This section includes, but is not limited to, temporary pipelines, wet taps/line stops, flexible pipe couplings, grooved and shouldered end couplings, joint restraint systems, field touch up, bolts, nuts, polyethylene wrap, warning/identification tape, tracer wire, gate well and extension stems, meter boxes, abandonment and removal of existing facilities, salvage, and disposal.

1.02 REFERENCE STANDARDS

The publications listed below form part of this specification to the extent referenced and are referred to in the text by the basic designation only. Reference shall be made to the latest edition of said standards unless otherwise called for.

AWWA C105	-	Polyethylene Encasement for Ductile-Iron Pipe Systems
AWWA C111	-	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C200	-	Steel Water Pipe – 6 In. (150mm) and Larger
AWWA C203	-	Coal-Tar Protective Coatings and Linings for Steel Water Pipelines – Enamel and Tape – Hot-Applied
AWWA C213	-	Fusion-Bonded Epoxy Coating for Interior and Exterior of Steel Water Pipelines
AWWA C606	-	Grooved and Shouldered Joints
AWWA C900	-	Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In. (100mm Through 300mm), for Water Transmission and Distribution
AWWA M11	-	Steel Pipe - A Guide for Design and Installation
AWWA	-	Guidelines for Distribution of Non-Potable Water
ASTM A 36/A 36M	-	Standard Specification for Carbon Structural Steel
ASTM A 47/A 47M	-	Standard Specification for Ferritic Malleable Iron Castings
ASTM A 53	-	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 108	-	Standard Specification for Steel Bars, Carbon, Cold Finished, Standard Quality
ASTM A 183	-	Standard Specification for Carbon Steel Track Bolts and Nuts
ASTM A 283/A 283M	-	Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates, Shapes and Bars
ASTM A 307	-	Standard Specification for Carbon Steel Bolts and Studs
ASTM A 325/A 325M	-	Standard Specification for High-Strength Bolts for Structural Steel Joints
ASTM A 510/A 510M	-	Standard Specification for General Requirements for Wire Rods and Course Round Wire, Carbon Steel

ASTM A 512	-	Standard Specification for Cold-Drawn Buttweld Carbon Steel Mechanical Tubing
ASTM A 536	-	Standard Specification for Ductile Iron Castings
ASTM A 568/A 568M	-	Standard Specification for Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality and Cold Rolled
ASTM D 2000	-	Standard Classification System for Rubber Products in Automotive Applications
ASTM F 593	-	Specifications for Stainless Steel Bolts, Hex Cap Screws, and Studs
ASTM F 594	-	Specification for Stainless Steel Nuts
ANSI B1.1	-	Unified Inch Screw Threads
ANSI B1.2	-	Gages and Gauging for Unified Inch Screw Threads
NSF	-	National Sanitation Foundation
SSPWC	-	Standard Specifications for Public Works Construction ("Greenbook")

California Administrative Code, Title 22

1.03 RELATED WORK SPECIFIED ELSEWHERE

FPUD Standard Drawings Typical

1.04 LINING CONTAMINATION PREVENTION

Volatile organic compounds present in the linings of items in contact with potable water or recycled water shall not exceed concentrations allowed by the latest requirements of the State Office of Drinking Water and Department of Health Services. Some products and materials may also require proof of NSF certification on the lining materials to be used.

1.05 TEMPORARY PIPELINES

Temporary pipelines, where shown on the Approved Plans or required by the District Engineer, provide temporary service to customers during construction.

1.06 PIPE TAPPING (WET TAP and LINE STOP)

All pipe tap (wet tap) connections to and line stops installed on existing pipelines, whether for mainline or service laterals, shall be performed by the Contractor as directed by the Engineer. The Contractor shall provide all materials and labor necessary to install taps or line stops including excavation, thrust blocks, backfill, compact, and repair pavement. The Contractor shall perform wet taps in general conformance with the wet tapping procedures provided in WAS standards.

The Contractor’s tapping, line stop and fitting manufacturer shall have at least ten years of demonstrated expertise in the field of hot tapping and line plugging asbestos cement pipe and concrete cylinder pipe. He shall also have similar experience with hot tap welding on concrete cylinder pipe, and similar experience with manufacturing pressure fittings for these procedures. The Contractor shall submit the qualifications of these subcontractors prior to the start of work. Line stop shop drawings including materials and procedures to be used for each specific site will be submitted also.

1.07 JOINT RESTRAINT SYSTEMS

Joint Restraint Systems may be used for PVC or ductile-iron pipe when shown on the Approved Plans or with prior approval of the District Engineer. Contractor shall submit shop drawings and catalog data for joint restraint systems in accordance with Section 1, General Conditions.

1.08 CORROSION PROTECTION

Polyethylene encasement or wax tape per Section 13110 shall be used for all ferrous metal materials not otherwise protectively coated.

A. Polyethylene wrap or sleeves shall be used for the protection of buried ductile-iron pipe, appurtenances, and valves.

B. Purple-colored polyethylene wrap or sleeves may also be installed around buried pipe for recycled water identification.

1.09 WARNING/IDENTIFICATION TAPE

6 Inch warning/identification tape shall be installed to identify location of underground utilities and to act as a warning against accidental excavation of buried utilities. Warning/identification tape shall be used on all underground water and recycled water mains, potable and recycled water irrigation systems, sewer mains, and all related appurtenances. Warning/identification tape shall also be used on cathodic protection wiring systems and tracer wire brought into and out of access ports.

1.10 TRACER WIRE

Tracer wire shall be installed on all buried recycled water mains (PVC Pipe) for the purpose of providing a continuous signal path used to determine pipe alignment after installation. Tracer wire is not required in installation of sewer mains.

1.11 GATE WELLS

Gate wells shall be used for buried valves 50mm (2”) and larger, unless otherwise indicated on the Standard Drawings. Gate well lids shall be used on all gate wells.

1.12 VALVE STEM EXTENSIONS

Valves 100mm (4”) and larger require valve stem extensions to be installed when the valve-operating nut is more than 1.5m (5') below grade or as required by the District Engineer. All valves 50mm (2”) and smaller requiring the installation of a gate well shall include a valve stem extension in accordance with the Standard Drawings.

1.13 METER BOXES

Meter boxes shall be used for water meters and other appurtenances as shown on the Standard Drawings.

1.14 CURB IDENTIFICATION MARK FOR SERVICES

The Contractor shall mark the location of all potable water, recycled water, and sewer laterals at the curb crossing by stamping the face of the curb in 50mm (2”) high letters as described below:

A. Potable water laterals shall be stamped with a letter “W”.

B. Recycled water laterals shall be stamped with the letters “RW”.

C. Sewer laterals be stamped with a letter “S”.

1.15 FIELD REPAIR OF DAMAGED COATINGS

All surfaces of metallic appurtenances in contact with potable water and not protected from corrosion by another system shall be shop-coated by the manufacturer. Appurtenances with damaged coatings shall be repaired or replaced as directed by the District Engineer. Touch-up of damaged surfaces, when allowed by the District Engineer, shall be performed in accordance with the manufacturer’s recommendations.

1.16 MAIN LINE STRAINER

Each pressure reducing station shall come equipped with a main line strainer placed immediately upstream of all valves and appurtenances as indicated.

PART 2 MATERIALS

2.01 TEMPORARY PIPELINES

Temporary piping layout, materials and appurtenances shall be as indicated on the approved submittal.

2.02 FLEXIBLE/TRANSITION PIPE COUPLINGS

Flexible or transition pipe couplings shall be in accordance with the Approved Materials List and as described below:

A. Couplings must conform to the latest edition of AWWA C219.

B. Steel Couplings shall have middle rings made of steel conforming to ASTM A 36/A 36M, A 53 (Type E or S), or A 512 having a minimum yield strength of 207 MPa (30,000 psi). Follower rings shall be ductile-iron per ASTM A 536, or steel per ASTM A 108, Grade 1018 or ASTM A 510, Grade 1018. Minimum middle ring length shall be 175 mm (7") for pipe sized 150 mm (6") through 600 mm (24").

C. Sleeve bolts shall be made of stainless steel per ASTM A193 or Type 304 and shall have a minimum yield strength of 276 MPa (40,000 psi), an ultimate yield strength of 414 MPa (60,000 psi), and shall conform to AWWA C111.

D. Coupling Shall be restrained.

E. Fusion bonded coating for interior and exterior per Section 09915.

F. Pressure rating: 250 psi

2.03 SHOULDERED COUPLINGS FOR DUCTILE IRON OR STEEL PIPE

Shouldered couplings shall be in accordance with the Approved Materials List and as described below:

A. Shoulder couplings shall be flexible type and provide for some expansion, contraction, and deflection. Rigid couplings will not be accepted.

B. Use square-cut shouldered ends per AWWA C606. Shouldered-end couplings shall be malleable iron per ASTM A 47, or ductile iron per ASTM A 536. Gaskets shall be per ASTM D 2000.

C. Bolts for exposed service shall conform to ASTM A 183, 69 MPa (10,000 psi) tensile strength.

D. Pressure rating: 800 psi

2.04 JOINT RESTRAINT SYSTEMS

A. Joint Restraint Systems shall be ductile-iron and shall consist of a split-ring restraint with machined (not cast) serrations on the inside diameter and connecting bolts, and shall be selected from the Approved Materials List. Serrations shall provide positive restraint, exact fit, 360º contact, and support of the pipe wall.

B. Joint restraints shall be provided where shown on the drawings. Restraints shall include 316 stainless steel bolts and fusion bonded epoxy coated ductile iron parts (ASTM A536).

C. Restraint Devices for PVC Pipe shall incorporate a series of serrations on the inside diameter to provide positive restraint, exact fit, 360° contact, and support of the pipe wall.

D. Restraint Devices shall be manufactured of high strength ductile iron, ASTM A536, Grade 65-45-12 or ASTM A36 structural steel.

E. All Restraint Devices shall have a water working pressure rating equivalent to the full rated pressure of the PVC pipe on which they are installed, with a minimum 2:1 safety factor in any nominal pipe size.

2.05 RESTRAINED FLANGE ADAPTERS

A. Flange adapters shall be made of ductile iron conforming to ASTM A536 and have flange drilling and facing compatible with ANSI/AWWA C110/A21.10 and ANSI/AWWA C115/A21.15.

B. Restraint for the flange adapter shall consist of a plurality of individual actuated gripping wedges to maximize restraint capability. Torque limiting actuating screws shall be used to insure proper initial set of gripping wedges.

C. The flange adapter shall be capable of deflection during assembly, or permit lengths of pipe to be field cut, to allow a minimum of 0.6” gap between the end of the pipe and the mating flange without affecting the integrity of the seal.

D. For PVC pipe, the flange adapter will have a pressure rating equal to the pipe.

E. For ductile iron and Steel pipe, the flange adapter shall have a safety factor of 2:1 minimum.

F. For Steel Pipe greater than 12” provide 316 stainless steel restraining rods and weld restraining ears to pipe.

G. Nuts and bolts shall be Type 316 stainless steel

H. All components shall be manufactured and assembled in the United States. The purchaser shall, with reasonable notice, have the right to plant visitation at his/her expense.

I. The adapter shall have fusion bonded coating on both its interior and exterior per Section 09915.

2.06 BOLTS AND NUTS

If not identified in individual specification sections, bolts and nuts shall be as indicated below and shall be selected from the Approved Materials List.

A. Stainless steel bolts and nuts shall be used for the installation of pipelines 600mm (24") diameter and larger and for submerged flanges. Bolts and nuts shall be Type 304 stainless steel conforming to ASTM A193, Grade B8 and ASTM A194, Grade 8M with hex-heads for above ground applications and Type 316 stainless steel conforming to ASTM A193, Grade B8M for bolts, and Grade 8M for nuts for below ground applications.

B. All bolt heads and nuts shall be hexagonal, except where special shapes are required. Bolts shall be of such length that not less than 6.4mm (¼") or more than 12.7mm (½") shall project past the nut in tightened position.

2.07 POLYETHYLENE ENCASEMENT

Polyethylene encasement shall be as indicated below and shall be selected from the Approved Materials List. Polyethylene materials shall be kept out of direct sunlight exposure.

A. Polyethylene wrap and sleeves shall be a minimum 0.203mm (0.008” or 8 mil) thick linear low-density polyethylene film in accordance with AWWA C105.

B. Polyethylene wrap and sleeves shall be clear for use with potable water and purple for use with recycled water.

C. Polyethylene encasement shall be secured with 50mm (2”) wide polyethylene or vinyl adhesive tape or with plastic tie straps.

2.08 WARNING/IDENTIFICATION TAPE

Warning/identification tape shall be as indicated below and in accordance with the Approved Materials List.

A. Tape shall be an inert, non-metallic plastic film, laminated between two colored layers of plastic film, formulated for prolonged underground use that will not degrade when exposed to alkalis, acids, and other destructive substances commonly found in soil. Laminate shall be strong enough that the layers cannot be separated by hand.

B. Tape shall be puncture-resistant and shall have an elongation of two times its original length before parting.

C. Tape shall be colored to identify the type of utility intended for identification. Printed message and tape color shall be as follows:

Printed Message	Tape Color
Caution: Waterline Buried Below	Blue
Caution: Recycled Waterline Buried Below	Purple
Caution: Sewerline Buried Below	Green
Caution: Cathodic Protection Cable Buried Below	Red
Caution: Electric Line Buried Below	Red

Ink used to print messages shall be permanently fixed to tape and shall be black in color with message printed continuously throughout.

D. Tape shall be minimum 6 mm thick x 150mm (6") wide with a printed message on one side printed every 16 to 36 inches. Tape used with the installation of onsite potable and recycled water irrigation systems shall be a minimum of 75mm (3”) wide.

2.09 TRACER WIRE

Tracer wire shall be as indicated below and shall be selected from the Approved Materials List.

A. Tracer wire shall be #14 AWG solid copper UF type wire with cross-linked polyethylene insulation. The insulation shall be white or yellow in color.

B. Wire splices (at pipe tees, crosses, and laterals) shall be accomplished using a direct bury silicone-filled capsule tube with standard wire nut or silicone-filled wire nut connectors of the appropriate size selected from the Approved Materials List.

2.10 GATE WELLS

A. Gate wells for valves 50mm (2”) and larger shall be 200mm (8”) diameter Class 305 C900 PVC pipe selected from the Approved Materials List.

B. Gate wells for use in potable water system applications shall be white or blue.

C. Gate well lids shall be circular ductile-iron selected from the Approved Materials List and shall include a skirt for a close fit inside the upper portion of the gate well. Lids shall be cast with the District's name and the word "WATER" for use on potable water systems.

1. Unless otherwise indicated on the Approved Plans or directed by the District Engineer, gate well lids for valves 2-inch and larger shall be Type I in accordance with Standard Drawing W-19 & W-20 and selected from the Approved Materials List.

2. When indicated on the Approved Plans or when directed by the District Engineer, gate well frame and lids for valves wells shall be Type II in accordance with Standard Drawing W-19 consisting of a two-piece machined ductile-iron frame and lid selected from the Approved Materials List.

2.11 VALVE STEM EXTENSIONS

Stem extensions shall be complete with operating nut, location ring, and lower socket to fit valve-operating nuts. The configuration of the extension stem socket shall match that of the valve it operates.

A. Valve stem extensions for valves 50mm (2") or larger may be round or square hot-dipped galvanized steel tubing of solid design (no pinned couplings permitted) with guides in accordance with Standard Drawing W-19.

2.12 METER BOXES

Meter boxes shall be selected from the Approved Materials List.

A. Meter box sizes shall be as follows:

Meter box size	Meter box uses
250mm x 500mm (10" x 20")	25mm (1") water services
325mm x 600mm (13" x 24")	25mm (1") dual domestic/fire water services
425mm x 750mm (17" x 30")	50mm (2") water services and 50mm (2") through 150mm (6") blowoff assemblies

B. Meter box lids for use in potable water system applications shall be green.

C. Meter box lids for use in recycled water system applications shall be purple.

2.13 MAIN LINE STRAINER

A main line strainer shall be capable of removing unwanted solid particles in pipeline flow and help prevent fouling, debris, and particle buildup in automatic control valves.

The large flow area design, with a flat stainless steel strainer mesh perpendicular to flow, is optimized for low pressure drop applications.

Maintenance should be simplified with a compact H-pattern, requiring only top cover removal. The strainer shall be serviceable without removing from the pipeline. The strainer may be installed in any position; however, installation with cover up is recommended.

The body shall be ductile iron with fusion bonded epoxy coating and lining. The strainer shall be constructed of Type 316 stainless steel. Cover seal shall be Buna N synthetic rubber. Cover fasteners shall be stainless steel.

Strainer mesh size shall be standard 10 mesh, 2000 micron with 078" openings.

Each strainer must come equipped with an equal sized, ¼ turn ball valve in place of the standard drain plug. Ball valves shall be placed on the side of the strainer facing the inside of the vault as indicated.

Strainer must have ANSI Class 150 flanged ends with an overall pressure rating of 250 psi.

Manufacturer must provide a flow chart showing pressure drop with corresponding flow rate along with Cv values for various strainer sizes.

Strainer shall be Cla-Val model #X43H or equal.

2.14 LINE STOPS

A. **Installed On Steel Pipe.** Line stops shall have full encirclement reinforcement pads or approved equal and shall be designed to fully replace the materials removed by the hot tapping operation per the formulas provided in ANSI/ASME B31.1 104.2.1, or approved equal.

The flanged outlet on the main line plugging fitting shall be of closure locking type and the flange completion plug shall be designed as adequate for the design pressure limit of the piping system, as per ANSI/ASME B31.1 104.5.3, or approved equal.

Permanent blind flange, flange gasket and stud bolts shall be of a size, rating, type, and facing to match the flange on the line plugging fitting.

PART 3 EXECUTION

3.01 TEMPORARY PIPELINES

A. All temporary piping, fittings, and service connections shall be furnished, installed, and maintained by the Contractor, and the Contractor shall make connections to a water source designated by the District Engineer.

B. All pipe, valves, fittings, hose, and connections furnished by the Contractor shall be of good quality, clean, and suitable for conveying potable water in the opinion of the District Engineer.

C. The temporary pipe shall be installed in such a manner that it will not present a hazard to traffic and will not interfere with access to homes and driveways along its route.

D. Valves shall be installed at 60m (200') intervals or as directed by the District Engineer. The use of pressure reducing valves (PRV) may be required as directed by the District Engineer.

E. The Contractor shall be responsible for disinfecting all pipe, connections, flushing, and assisting the District in taking water samples for bacteriological testing in accordance with Section 15041.

F. Following disinfection and acceptance of the temporary pipe as a potable water system, the Contractor shall maintain continuous service through the temporary piping to all consumers normally served both directly and indirectly by the pipeline.

G. Upon completion of the work, the Contractor shall remove the temporary piping and appurtenances and shall restore all surfaces to the satisfaction of the District Engineer.

H. If repairs to temporary piping are necessary, Contractor shall make such repairs in a timely manner as directed by the District Engineer. If progress in making repairs is inadequate, or in the event of emergency, the District Engineer may take immediate corrective measures, which may include the performance of repair work by District forces or another contractor. All costs for corrective measures shall be borne by the Contractor.

3.02 LINE STOPS

A. **Installed on Steel Pipe**. The Contractor shall have the exact locations of the temporary line plugs excavated and a "window" of the outer concrete removed to expose the steel liner. Such window to be a length equal to at least the nominal inside diameter of the pipe and having a width exposing at least three circumferential reinforcement wires. At least three ultrasonic thickness readings must be taken and be within 10 percent of each other and the cylinder thickness shall be determined by the average of these three readings. The welded fitting process shall not be attempted on any pipe where the steel cylinder is thinner than14-gage (0.075 inches) or on any pipe where the steel cylinder, alone, will not be adequate to safely handle the pipe working pressure during all line

plugging operations.

1. Once the pipe conditions are known, the Contractor shall submit the line stop procedures assuring minimal damage to the pipe and, after plugging, have fittings and repairs that provide adequate facilities to handle design pressures.

2. Suitable permanent thrust blocking shall be formed, rebarred, poured, and allowed to cure on either side of the line plug fitting locations. Such thrust blocking shall be capable of supporting the gross weight load of the line plugging fitting and temporary equipment plus the total blinded off thrust load imposed by the pipe's pressurized fluid contents bearing against the temporary plug; plus any additional prudent load allowances such as water hammer, etc. Such thrust blocking shall clear the line plugging fitting as recommended by the manufacturer.

3. All welding done on the live pipe cylinder shall be performed by a field welder certified as having not less than one year's experience welding live hot tap connections and having further being connection pipe cylinders of a wall thickness as this as the subject cylinder. The Contractor shall submit the welder's qualifications prior to the start of work.

4. Existing reinforcing shall be tack welded to the steel cylinder prior to cutting.

5. The entire area of the cylinder shall be cleaned to bright metal and inspected for soundness and condition.

6. A suitable pressure cover shall be attached to the flange and a cold hydrostatic test shall be performed to test the integrity of the field weld and components. The test pressure shall be coordinated with the District.

7. The proposed pressure equalization method shall be submitted by the Contractor for District approval. No attempts to install or remove temporary line plugs shall be made until pipe pressure is perfectly equal on both sides of the plug.

8. Suitable permanent load blocking shall be installed beneath the line plugging fitting and the previously installed main blocking to transfer any subsequent machinery weight, bending moments or pressure imposed loads from the pipe to the main blocking and undisturbed surrounding earth.

9. The hot tap cutter shall be equipped with cutting teeth of a proven design and material suitable for cutting the combination steel and concrete portions of the hot tapped coupon. The coupon shall be removed and inspected for completeness and signs of corrosion. The coupon shall be turned over to the District for final inspection.

10. The line plugging seal diameter shall be confirmed to be correct for the pipe I.D. as indicated by the removed hot tap coupon and the seal is attached to the temporary line plugging machine and lubricated.

11. The Contractor shall coordinate with District staff to minimize flow in the

existing pipe

12. Provisions shall be made to handle any incidental leakage across the like plug which may occur due to pipe bore conditions.

13. At the completion of work, the line pressures shall be equalized and the plug removed, completion plugs installed and blind flanges installed per the approved procedures.

14. The entire installation shall be wired or rebarred and mortared to restore the piping system to its original strength and protected condition.

3.03 CONNECTION TO EXISTING FACILITIES (WET TAPS AND CUT-IN INSTALLATIONS)

All connections to existing facilities, including wet taps on active pipelines, removal and replacement installations and cut-in installations, shall be performed by the Contractor and shall be performed in strict accordance with the following procedures. In addition, wet taps shall be performed in accordance with WAS wet tap procedures as shown in Appendix A, Various WAS Standards. The District Engineer must approve all work proposed by Contractor prior to allowing access to the work site by District personnel.

The Contractor shall furnish the tapping sleeve or tee, valves, and all other materials as called for in the Standard Specifications in accordance with the Approved Materials List or as noted on the approved plans. The Contractor shall provide all equipment and labor required for the excavation and installation of the connection including but not limited to thrust blocks, backfill, testing and pavement replacement. In certain circumstances the Contractor may be required to provide a water truck or temporary piping as part of the equipment for making the connections. In addition, the Contractor shall assist the District in alleviating any hardship incurred during a shutdown for connections. Emergency standby equipment or materials may be required of the Contractor by the District Engineer.

Wet taps, removal and replacement installations or cut-in tee and valve installations shall be performed as follows:

A. Prior to construction, Contractor shall pothole the existing pipe at the location of the proposed connection. The District Engineer shall inspect the pothole prior to Contractor's repair of trench. Refer to Section 01000 for protection of existing facilities. Contractor shall record the following information on as-built drawings:

   1. Pipe size, outside diameter.

   2. Pipe type such as ACP, CCP, PVC, Ductile-Iron or Steel.

   3. Pipe class and/or pressure rating.

   4. Elevation, grade, and alignment.

   5. Location of collars, pipe bells, fittings or couplings, thrust blocks, if found.

   6. Potential conflicts with existing utilities.

C. The new pipeline shall have successfully passed pressure testing in accordance with Section 15044 and disinfection and bacteriological testing in accordance with Section 15041 prior to proceeding with the connection to the existing pipeline.

D. After the District Engineer has given approval to proceed with the connection, the Contractor shall schedule with the District Engineer for the wet tap, removal and replacement installation, or cut-in installation. Submittals shall show the proposed work location and the location of existing valves required to be shut down to isolate the work location.

1. Shutdowns will be scheduled at the convenience of the District. If required by the District shutdowns may be scheduled for nights or weekends.

2. The District Engineer may postpone or reschedule any shutdown operation if, for any reason, the District Engineer believes that the Contractor is improperly prepared with competent personnel, equipment, or materials to proceed with the connection.

3. If progress in completing the connection within the time specified is inadequate, the District Engineer may order necessary corrective measures. Corrective measures may consist of directing District personnel or another contractor to complete the work. All costs for corrective measures shall be borne by the Contractor.

E. Contractor may proceed with excavation only when pothole has been completed, materials have been approved and delivered, installation has been scheduled, and a copy of the approved traffic control plan has been supplied to the District Engineer.

1. The Contractor shall saw-cut pavement, excavate and provide and install shoring and steel plating, prior to the wet tap, removal and replacement installation or cut-in installation.

2. The Contractor shall provide lights, barricades, and traffic control in accordance with the agency of jurisdiction and as deemed necessary for the excavation by the District Engineer.

3. The Contractor shall de-water existing mains in the presence of the District Engineer and in accordance with Sections 15041 and 02223. Water shall be de-chlorinated prior to disposal. The Contractor shall be prepared to deal with leaking valves and water from those valves to complete the shutdown. Only District personnel are authorized to operate existing valves. The Contractor shall be responsible for any and all damage resulting from unauthorized operation of existing District facilities.

4. In areas where removal and replacement installations or cut-ins are to be performed, the Contractor shall line the bottom of the trench with 300 to 450mm (12” to 18”) of 19mm (¾”) rock and install a 300 to 400mm (12” to 16”) deep sump for dewatering the trench bottom.

5. The Contractor shall perform the following work for wet taps, removal and replacement installations and cut-in installations:

   a. Wet taps: Disinfect and install the tapping saddle and tapping valve and perform tapping operations in accordance with Appendix A, Various WAS Standards.

   b. Removal and replacement installations or cut-ins: Cut/remove portions of existing mains, and disinfect and install tees, valves, couplings, and appurtenances required to complete the closure. The Contractor shall discard pipe and appurtenances removed from service in accordance with this Section.

6. After the Contractor has performed tapping or removal and replacement installation/cut-in operations, and the District Engineer has given approval to proceed, the Contractor shall complete the installation as shown on the Approved Plans in accordance with the Standard Specifications including, but not limited to:

   a. Disinfecting and installing the pipe section(s) necessary to make the closure to the new system.

   b. Installing and setting the valve gate well(s) in accordance with the Standard Drawings.

   c. Installing thrust and anchor blocks in accordance with Section 03300.

   d. Completing all backfill and compaction of the trench in accordance with Section 02223.

   e. Repairing or replacing pavement as necessary in accordance with agency of jurisdiction requirements.

3.04 FLEXIBLE/TRANSITION PIPE COUPLINGS

Flexible/transition pipe couplings shall not be considered for use, unless approved by the District Engineer and for special application.

3.05 SHOULDERED COUPLINGS FOR DUCTILE-IRON OR STEEL PIPE

Shouldered couplings shall be installed in accordance with the manufacturer’s recommendations and as described below:

A. Shouldered joint couplings shall be installed per AWWA C606 and the manufacturer's recommendations.

B. Clean loose scale, rust, oil, grease, and dirt from the pipe or fitting groove and touch up the epoxy coating as necessary, allowing time for curing before installing the coupling.

C. Clean the gasket before installation. Apply a lubricant selected from the

Approved Materials List to the gasket exterior including lips, pipe ends, and housing interiors.

D. Fasten the coupling alternately and evenly until the coupling halves are seated. Follow the manufacturer's recommendations for bolt torque using a properly calibrated torque wrench.

3.06 JOINT RESTRAINT SYSTEMS

Joint Restraint Systems shall be installed as shown on the Approved Drawings, in accordance with the manufacturers' recommendations and as described below:

A. Split ring restraint shall be installed on the spigot end of pipe, connected to a back-up ring which seats behind the bell of the adjoining pipe or fitting or directly to the fitting. All joint restraint devices shall be installed in accordance with the manufacturers' instructions

B. Restraint devices may be installed prior to lowering pipe into the trench only with the approval of the District Engineer.

3.07 RESTRAINED FLANGE ADAPTERS

Restrained Flange Adapters shall be installed as shown on the Approved Drawings, in accordance with the manufacturers' recommendations and as described below:

A. Determine pipe material. If product requires spacers under the screws, make sure they are available prior to assembly.

B. Cut pipe to required length. Clean the end for approximately one foot with a wire brush if needed removing all excess paint and foreign material. Clean the opposing flange. Place the restraint ring on the clean pipe with the lip facing the plain end.

C. Lubricate and place the gasket on the clean pipe following the restraint ring.

D. Install the O-ring into the gasket ring groove if required by manufacturer.

E. Bring the pipe and flanges together within the maximum allowed deflection and maximum allowable gap to the flange face. Check manufacturer's requirements for these allowable dimensions.

F. Slide the gasket ring and restraining ring until contact is made with the opposing flange.

G. Insert and tighten all flange bolts. Torque in an alternating manner per the manufacturer's requirements and limits.

H. Tighten the actuating screws in an alternating manner until all wedges touch the pipe. Continue tightening the nuts in an alternating pattern until all the torque-limiting nuts have been twisted off.

I. If removal is necessary, utilize the hex head provided. For reinstallation, follow

the steps above and torque the screws per the manufacturer's requirements.

3.08 BOLTS AND NUTS

A. All bolts and nuts shall be new and unused. Bolts shall not be reused once tightened. Used bolts and nuts shall be discarded and removed from the job site.

B. Bolts and nuts shall be cleaned, if needed, by wire brushing and shall be lubricated prior to assembly.

C. Tighten nuts uniformly and progressively in a "star" pattern.

D. Buried bolts and nuts shall receive a heavy coat of protective grease selected from the Approved Materials List prior to being wrapped with polyethylene.

E. All stainless steel bolts shall be coated with an anti-seize compound selected from the Approved Materials List.

3.09 POLYETHYLENE ENCASEMENT

A. Polyethylene encasement shall completely encase and cover all metal surfaces.

Pipe and pipe-shaped appurtenances: All ductile-iron pipe and pipe-shaped appurtenances such as bends, reducers, and offsets shall be encased with polyethylene sleeves in accordance with Method A described in AWWA C105, or with polyethylene wrap in accordance with Method C described in AWWA C105.

Odd-Shaped Appurtenances: Odd-Shaped Appurtenances such as tees and crosses shall be encased with polyethylene wrap in accordance with AWWA C105.

Valves: Valves shall be encased with polyethylene wrap in accordance with AWWA C105 such that only the stem and operating nut are exposed and the wrap shall be attached so that valve operation will not disturb the wrapping or break the seal.

B. Polyethylene sleeves shall be secured with polyethylene or vinyl adhesive tape or plastic tie straps at the ends and quarter points along the sleeve in a manner that will hold the sleeve securely in place during backfill. Polyethylene wrap shall be secured with polyethylene or vinyl adhesive tape or plastic tie straps in a manner that will hold the wrap securely in place during backfill.

3.10 WARNING/IDENTIFICATION TAPE

Warning/Identification Tape shall be installed as described below and in accordance with the Standard Drawings.

A. Tape shall be placed at the top of the pipe zone 300mm (12") above and centered over the utility intended for identification. Tape used with onsite potable and recycled water irrigation systems shall be installed at 150mm (6") above the pipe.

B. Tape shall be installed with the printed side up and run continuously along the entire length of the utility intended for identification. Tape shall be installed on the main piping and all appurtenant laterals, including blowoffs, air valve assemblies, fire hydrants, and services. Tape splices shall overlap a minimum of 600mm (24”) for continuous coverage.

C. Tape shall be installed prior to placement of the Trench Zone Backfill.

3.11 TRACER WIRE

Tracer wire shall be installed as described below and in accordance with the Standard Drawings.

A. Tracer wire shall be installed with all PVC water and recycled water mains.

B. Wire shall be placed on the top centerline of the pipeline and shall run continuously along the entire length of pipe prior to placement of trench backfill. Wire shall be mechanically and electrically continuous throughout the pipeline, including within pipe casings.

C. Tracer wire shall be secured to the pipe at 1.8m (6') intervals with plastic adhesive tape, duct tape or plastic tie straps. The wire may alternately be secured to the pipe by looping the tracer wire around itself such that tracer wire remains continuous atop the pipe during backfill operations.

D. Tracer wire access ports shall be installed in accordance with the Standard Drawings within the concrete splash pad of all fire hydrants installed as a part of the work. In addition, tracer wire may terminate within meter boxes, blow off boxes, CP test boxes or air valve enclosures as shown on the Approved Drawings or as directed by the District Engineer at intervals of not more than 305m (1,000'). Locations of all tracer wire access ports installed shall be noted on the field record drawings.

E. Wire shall extend into the access port and shall terminate with a coiled 600mm (24") length of wire. All tracer wire not attached to piping shall be installed, without splices, within a conduit at a minimum depth of 600mm (24”) in accordance with the Standard Drawings.

F. Splices shall be installed only when necessary and shall be made using wire connectors selected from the Approved Materials List.

G. The Contractor shall test tracer wire for electrical continuity in the presence of the District Engineer prior to the installation of any paving over atop pipelines or appurtenances. Testing shall be accomplished using a device capable of detecting improper connections or ground fault interruptions.

3.12 GATE WELLS

Gate wells shall be installed per the Approved Plans and as described below.

A. Gate wells shall be installed with lids flush with the final surface. No more than two 25mm (1”) adjustment rings shall be used. Gate wells and adjustment rings

shall be accurately cut perpendicular to the length of the piping used.

B. Gate wells shall be color-coded to identify the use of the valve installed.

1. The inside portion of the gate well shall be identified with an identification marking. Paint color shall be as follows:

Color	Gate Well Lid (inner) and (PVC) Gate Well for:
Red	All Normally Closed System Valves (NCV)
Yellow	All Fire Hydrant Valves
Purple	All Recycled Waterline System Valves

2. The top exterior portion of the gate well lid and ring shall be coated in accordance with Section 09900, by color noted below:

Color	Gate Well Lid (outer) for:
Red	All Normally Closed System Valves (NCV), (not drains)
Yellow	All Fire Hydrant Valves
Silver	All System In-Line, Tee, Blow-off and AAV valves All Recycled Waterline System Valves
Green	Sewer Force Main Valves
Purple	All Outfall Valves

3.13 VALVE STEM EXTENSIONS

A. Valves 50mm (2”) and larger require valve stem extensions to be fabricated and installed in accordance with the Standard Drawings when the valve-operating nut is more than 1.5m (5’) below grade. Stem extensions shall be of sufficient length to bring the operating nut to a point between 300mm (12”) and 450mm (18”) below the gate well lid.

3.14 METER BOX INSTALLATIONS

Meter boxes shall be installed at the elevations and locations shown on the Approved Plans and in accordance with the Standard Drawings. Near the completion of the project, a final meter box adjustment to finish grade may be required. Water meters shall not be installed until final adjustments are made to the meter box and are approved by the District Engineer.

3.15 INSTALLATION OF TEMPORARY END CAPS TO MAINTAIN SERVICE

Before excavating for new mains that are to replace existing pipes or services, it may be necessary to install temporary end caps on existing pipes that are later to be abandoned or connected in order to maintain service to customers or fire protection during construction. When indicated on the Approved Plans or when directed by the District Engineer, Contractor shall install and maintain such temporary end caps as indicated below and in accordance with the Standard Drawings.

A. For existing water mains 350mm (14”) or less in diameter, the existing pipe shall be cut cleanly and fitted with a rubber-gasketed ductile-iron solid end cap specifically designed for the size and type of pipe being temporarily capped. The

temporary end cap shall be adequately braced with a concrete thrust block poured against undisturbed material or as otherwise required to insure that no movement or leakage occurs.

B. Temporary end caps shall be fitted with 50mm (2") tapped outlets in accordance with the Standard Drawings to provide temporary 50mm (2") blowoffs or connections to temporary water sources if indicated on the Approved Drawings or if directed by the District Engineer.

C. Existing pipes 400mm (16") or larger shall not be fitted with temporary end caps.

3.16 PERMANENT ABANDONMENT OF PIPELINES AND APPURTENANCES

When indicated on the Approved Plans or when directed by the District Engineer, existing pipelines to be abandoned shall be disconnected from all source pipelines and shall remain in place in accordance with the Standard Drawings and the modifications and instructions listed below:

A. All above-ground appurtenances connected to pipelines to be abandoned shall be removed and disposed of or salvaged in accordance with this Section.

B. All piping and appurtenances buried at a depth of 600mm (24") or less and connected to pipelines to be abandoned shall be removed and disposed of or salvaged in accordance with this Section. Remaining pipe ends, gate wells, and other appurtenances cut at a depth of 600mm (24") shall be removed entirely or filled with concrete. Excavated areas shall be replaced with compacted backfill and surfaces shall be repaired in accordance with these Standard Specifications.

C. Pipe 100mm (4") and smaller to be abandoned shall be excavated at intervals of 60m (200'), short sections of pipe shall be removed, and pipe ends shall be encased in concrete.

D. Pipe 150mm (6") through 350mm (14") to be abandoned shall be excavated at intervals of 60m (200'), and pipe shall cut and plugged with concrete in accordance with the Standard Drawings or shall be entirely filled by pressure-grouting.

E. When existing pipe 350mm (14") or less is excavated for abandonment, each excavation is considered as a single "cut-and-plug."

F. Abandoned pipe 400mm (16") and larger shall be entirely filled by pressure-grouting or by blown sand.

G. Ends of all pipe segments to be abandoned shall be filled with concrete a minimum of 10 feet each end, in accordance with the Standard Drawings.

H. All valves on pipelines to be abandoned shall be turned to the closed position.

I. Water services to be abandoned that are connected to pipelines that will remain in service shall be abandoned in-place and deactivated at the corporation stop in accordance with the Standard Drawings. Water services connected to pipelines to be abandoned shall be abandoned in-place and cut ends shall be crimped.

3.17 REMOVAL OF PIPELINES AND APPURTENANCES

A. Existing pipe and appurtenances shall be completely removed when indicated on the Approved Plans or as directed by the District Engineer. All materials removed during construction operations shall be salvaged or disposed of in accordance with this Section.

B. When fittings, appurtenances, or pipe segments are removed from pipelines that are to remain in service, the removed portions shall be replaced with straight segments of pipe and appropriate couplings selected from the Approved Materials List.

C. Removal of asbestos-cement pipe (ACP) and appurtenances shall be in accordance with all applicable State and Federal requirements, and disposal shall be in accordance with the requirements of this Section.

D. Backfill, compaction, and surface repair of all excavations for removal of pipe and appurtenances shall be made in accordance with the Approved Plans, these Standard Specifications, and in accordance with the requirements of the agency of jurisdiction or as directed by the District Engineer.

3.18 RECONNECTIONS

Existing service laterals or appurtenances shall be connected to new pipelines. Contractor may encounter unused service laterals or piping appurtenant to an existing pipeline being replaced. Laterals and appurtenant piping that will not be connected to new pipelines shall be abandoned in accordance with the requirements of this Section.

3.19 SALVAGE

When the Contractor is required to remove existing pipe and appurtenances, such materials may, when shown on the Approved Plans or directed by the District Engineer, be considered salvage. All materials identified as salvage are considered property of the District. The Contractor shall temporarily stockpile all material identified as salvage in a location that will not disrupt traffic or otherwise create an unsafe condition and shall deliver such materials as directed by the District Engineer.

3.20 DISPOSAL

All materials removed during construction operations and not identified by the District Engineer as salvage shall be legally disposed of in accordance with all applicable Local, State, and Federal requirements.

Disposal of asbestos-cement pipe requires special handling and attention, including but not limited to, encapsulation within airtight packaging, submittal of certification letters and/or waste profile statements, and the use of a Cal-OSHA registered asbestos abatement contractor to transport and dispose of such wastes. The District Engineer shall be provided with copies of all applicable documentation regarding the transportation and disposal of asbestos-cement pipe. Contractor shall comply with all applicable regulations and all requirements of the disposal site. Contractor is responsible for all costs associated with disposal of materials, specifically including any

materials that may contain asbestos.

END OF SECTION

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SECTION 15041

DISINFECTION OF PIPE AND WATER STORAGE FACILITIES

PART 1 GENERAL

1.01 DESCRIPTION

This section describes requirements for disinfection by chlorination of potable water mains, services, pipe appurtenances and connections.

1.02 REFERENCED STANDARDS

The publications listed below form part of this specification to the extent referenced and are referred to in the text by the basic designation only. Reference shall be made to the latest edition of said standards unless otherwise called for:

AWWA B301	Standard for Liquid Chlorine
AWWA C651	Disinfecting Water Main
AWWA C652	Tank Disinfection

1.03 RELATED WORK SPECIFIED ELSEWHERE

Section 15044	AWWA Standard Methods for the Examination of Water and Waste Water Hydrostatic Testing of Pressure Pipe
Section 15056	Ductile Iron Pipe and Fittings
Section 15057	Copper Tube, Brass and Bronze Pipe Fittings
Section 15064	PVC Pipe (C900)
Section 15070	PVC Pipe (C905)
Section 15076	CML&C Steel Pipe and Specials

1.04 SERVICE APPLICATION

A. All water mains and appurtenances taken out of service for inspection, repairs, or other activity that might lead to contamination shall be disinfected before they are returned to service.

B. All new water mains and temporary high lines shall be disinfected prior to connection to the District's existing system.

C. All components incorporated into a connection to the District's existing system shall be disinfected prior to installation.

1.05 SUBMITTALS

A. A written disinfection and dechlorination plan signed by a certified chlorinator shall be submitted to the District for review and approval prior to starting disinfection operations.

B. A Record of Disinfection shall be provided to the District water quality staff prior to sampling. The Record of Disinfection shall include the time of injection, time length of injection and log of disinfection. Disinfection must be completed by a licensed and certified company.

1.06 DELIVERY, STORAGE AND HANDLING

Chlorination and dechlorination shall be performed by competent individuals knowledgeable and experienced in the operation of the necessary application and safety equipment in accordance with applicable Federal, State and Local laws and regulations. The transport, storage and handling of these materials shall be performed in accordance with Code of Federal Regulations (CFR), and the California Occupational and Health Administration (Cal-OSHA) - California Code of Regulations (CCR), Title 8.

1.07 DISINFECTION AND HYDROSTATIC TESTING

The specified disinfection of the pipelines shall not be performed concurrently with the hydrostatic testing. Disinfection shall only be performed after lines have been flushed and have passed hydrostatic tests per Section 15044.

1.08 CONNECTION TO EXISTING MAINS

Prior to connection to existing mains, disinfection and bacteriological testing shall be performed in accordance with this specification, and hydrostatic testing shall be performed per Section 15044. District authorization for connection to the existing system shall be given only on the basis of acceptable hydrostatic, disinfection and bacteriological test results.

PART 2 MATERIALS

2.01 SODIUM HYPOCHLORITE (LIQUID)

Sodium hypochlorite is available in liquid form in glass or plastic containers, ranging in size from 1 qt. to 5 Gal. The solution contains approximately 10% to 15% available chlorine.

2.02 GRANULAR HYPOCHLORITE

Granular hypochlorite may be used when mixed into a solution containing approximately 10% to 15% available chlorine. When using granular hypochlorite in solution, follow the procedure for sodium hypochlorite solution in this section

PART 3 EXECUTION

3.01 GENERAL

A. Disinfection of pipelines shall not proceed until all appurtenances and any necessary sample ports have been installed and the District Engineer provides authorization.

B. Every effort shall be made to keep the water main and its appurtenances clean and dry during the installation process.

C. All piping, valves, fittings, and appurtenances which become contaminated during installation shall be cleaned, rinsed with potable water, and then sprayed or swabbed with a 5% sodium hypochlorite disinfecting solution prior to installation.

D. Water mains under construction that become flooded by storm water, runoff, or ground water shall be cleaned by draining and flushing with metered potable water until clear water is evident. Upon completion, the entire main shall be disinfected using a method approved by the Engineer.

3.02 METHODS

A. Sodium Hypochlorite Solution (Liquid)

1. Sodium hypochlorite solution shall be used for cleaning and swabbing piping and appurtenances immediately prior to installation and for disinfecting all components of connections to the District's existing system.

2. Sodium hypochlorite solution may be used for the initial disinfection of newly installed water mains. The solution shall be applied at a terminus of the system to be chlorinated using an injector which can adjust the amount of solution being injected into the piping system. The solution shall be injected at the appropriate concentration to achieve the specified concentration range of chlorine throughout the entire piping system. Where pumping equipment is used in conjunction with an injector, an integral backflow prevention device shall be installed and connected to the potable water supply.

3. Pumping equipment, piping, appurtenances and all other equipment in contact with potable water shall be disinfected prior to use. Water trucks shall not be used for disinfection of pipelines.

4. Sodium hypochlorite solution may also be used to increase the total chlorine residual if the concentration from the initial chlorination of the system is found to be low. The solution shall be added to the system in sufficient amounts at appropriate locations to ensure that the disinfecting solution is present at a concentration within the specified range throughout the piping system.

3.03 PROCEDURE FOR DISINFECTING WATER MAINS AND APPURTENANCES

A. The pipeline shall be filled at a rate not to exceed 300 GPM or a velocity of 1 foot per second (156 GPM in an 8-inch pipe), whichever is less.

B. Disinfection shall result in an initial total chlorine concentration of 50 ppm to 150 ppm. This concentration shall be evenly distributed throughout the system to be disinfected.

C. All valves shall be operated with the disinfection solution present in the pipeline. All appurtenances such as air-vacuum relief valves, blowoffs, hydrants, backflow prevention devices, and water service laterals shall be flushed with the treated water for a sufficient length of time to ensure a chlorine concentration within the specified range in all components of each appurtenance. (Note the limitations for discharge of chlorinated water outlined below.)

D. The Contractor will verify the presence of the disinfection solution throughout the system by sampling and testing for acceptable chlorine concentrations at the various appurtenances

and/or at the test ports provided by the Contractor. Areas of the system found to be below the specified chlorine concentration level shall receive additional flushing as noted above and/or additional disinfection solution as necessary. (Note the limitations for discharge of chlorinated water outlined below.) All testing will be done in the presence of the District Engineer.

E. The chlorinated water shall be retained in the system for a minimum of 24 hours. The District Engineer will test the total chlorine residual. The system shall contain a total chlorine residual of not less than 80% of the initial total chlorine residual before the 24-hour soaking period began. If the total chlorine residual has decreased more than 20%, the system shall be soaked for an additional 24-hour period. If the total chlorine residual has not deceased after this additional 24-hour period, the system shall be flushed in accordance with the procedure detailed herein. If the total chlorine residual has decreased, the system shall be flushed in accordance with the procedure detailed herein, and shall be re-disinfected.

F. Following a successful retention period as determined by the District Engineer, the chlorinated water shall be flushed from the system at its extremities and at each appurtenance, using potable water from a source designated by the District Engineer. The minimum water velocity during flushing shall be 3 feet per second or as directed by the District Engineer. Flushing shall continue until the replacement water in the new system is equal in chlorine residual to the potable source of supply as verified by the District Engineer. (Note the limitations for discharge of chlorinated water outlined below.)

G. The District will collect water samples and a California State certified drinking water laboratory will perform bacteriological testing, in accordance with paragraph 3.05 below, and provide a certificate of compliance to the District Engineer that the unit tested met the AWWA C651 requirements.

3.04 DISINFECTION OF WATER-STORAGE FACILITIES

Disinfection of water storage facilities shall be done in accordance with AWWA – C652.

3.05 DISCHARGE OF CHLORINATED WATER

A. Indiscriminate onsite disposal or discharge to sewer systems, storm drains, drainage courses or surface waters of chlorinated water is prohibited.

B. The environment to which the chlorinated water is to be discharged shall be examined by the Developer, Certified Chlorinator, and the District Engineer. Where necessary, federal, state and local regulatory agencies shall be contacted to determine special provisions for the disposal of chlorinated water. Any discharge of chlorinated water to the environment shall require the neutralizing of the chlorine residual by means of a reducing agent in accordance with AWWA C651, San Diego Regional Water Quality Control Board (SDRWQCB), Standardized Best Management Practices for Portable Water Discharges in Region 9 and the requirements of this specification.

C. A chlorine reducing agent shall be applied to the water prior to exiting the piping system. The Certified Chlorinator shall monitor the chlorine residual during the discharge operations. Total residual chlorine limits in these locations, and for the discharge of chlorinated water from the testing of pipelines to surface waters of the San Diego Region are as follows:

Total Residual Chlorine Effluent Limitations

Instantaneous Maximum - 0.02 ppm

The various methods of dechlorination available can remove residual chlorine to concentrations below standard analytical methods of detection, 0.02 ppm, which will assure compliance with the effluent limit. The Contractor will perform all necessary tests to ensure that the total residual chlorine effluent limitations listed above are met.

3.06 BACTERIOLOGICAL TESTING

A. A testing firm will perform bacteriological sampling and testing of all new system installations. The testing methodology employed shall be in accordance with AWA 651. The Certified Laboratory will analyze the samples for the presence of coliform bacteria and heterotrophic-type bacteria (heterotrophic plate count).

B. The evaluation criteria employed by the District for a passing test sample is as follows:

1. Coliform bacteria: no positive sample

2. Heterotrophic plate count (HPC): 500 colony forming units/mi or less.

3.07 REDISINFECTION

If the initial disinfection fails to produce satisfactory bacteriological test results, the pipeline system shall be re-flushed and re-sampled. If the second set of samples does not produce satisfactory results, the pipeline system shall be re-chlorinated, flushed, and re-sampled. The chlorination, flushing, and sampling procedure shall continue until satisfactory results are obtained. Re-disinfection and retesting shall be at the Contractor's expense.

3.08 DISINFECTING TIE-INS AND CONNECTIONS

Pipes, fittings, valves and all other components incorporated into connections with the District's existing system shall be spray disinfected or swabbed with a liquid chlorine solution in accordance with AWWA C651 and as specified herein. Upon connection to the main, the line shall be flushed as directed by the District Engineer. Disinfection by this method is generally limited to assemblies of 20-feet or less in length. Alternate methods such as "pre-disinfection" prior to installation in accordance with AWWA C651 may be required at the discretion of the District Engineer.

END OF SECTION

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SECTION 15043

SEWER LEAKAGE AND INFILTRATION TESTING

PART 1 GENERAL

1.01 DESCRIPTION

This section describes the requirements and procedures for leakage and infiltration testing of gravity sewer systems.

1.02 REFERENCED STANDARDS

The publications listed below form part of this specification to the extent referenced and are referred to in the text by the basic designation only. Reference shall be made to the latest edition of said standards unless otherwise called for:

UNI-B-6	Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe
SSPWC	Standard Specifications for Public Works Construction ("Greenbook")

1.03 RELATED WORK SPECIFIED ELSEWHERE

Section 02223	Trenching, Backfilling and Compacting
Section 03461	Precast Concrete Manholes
Section 15044	Hydrostatic Testing of Pressure Pipe

1.04 REQUIREMENTS PRIOR TO TESTING

Trenching for all dry utilities such as electrical, telephone and cable television shall be completed prior to performing any tests on the sewer pipe.

1.05 TESTING

A. Leakage Test: Each section of sewer pipe between two successive manholes shall be tested for leakage. The sewer laterals to the property line shall be included in the test.

B. Infiltration Test: In addition to the leakage test, an infiltration test shall be made where groundwater is encountered, or evidence exists that ground water has encroached to the elevation of the sewer, and as directed by the District Engineer.

C. Closed Circuit Television: A closed circuit television inspection shall be required to be performed, by the District, on the sewer installation.

D. All tests shall be made in the presence of the District Engineer.

E. Testing may be repeated, as directed by the District Engineer, if the subsequent construction operations of the Contractor or others may have damaged or affected the structural integrity of the sewer pipe and/or laterals.

F. The official District test will not be made until after all other utilities have been installed and trench compaction verified.

G. All tests must be completed before the street or trench is paved, unless otherwise allowed by the District Engineer.

H. Vacuum testing of manholes shall be performed in accordance with Section 03461.

PART 2 MATERIALS

The Contractor shall furnish all equipment and materials required for testing.

PART 3 EXECUTION

3.01 AIR TEST FOR PVC GRAVITY SEWERS

A. PVC pipe shall be air pressure tested in accordance with the test procedures outlined in Green Book Section 306-1.4.4, Amendment 306-1.4.4.1, and the Low Pressure Air Test for Sanitary Sewers as published by the National Clay Pipe Institute. The test shall be made only after the line has been properly installed including any necessary test fittings, and backfilled.

B. Test plugs shall be carefully placed at each end of the section of the line to be tested. When all necessary test equipment is in place, a compressed air supply shall be attached within the line and increased to four (4) pounds per square inch (4 psi). After the air supply is securely turned off or disconnected, there shall be a two (2) minute waiting period to allow stabilization of air within the sewer line before the actual test period begins. Air may be added only to maintain a pressure of 4.0 psig. When the internal pressure decreases to 3.5 psig, timing shall start and the seconds counted until the pressure has decreased to 2.5 psig.

C. Minimum permissible pressure holding times for sewer main, with or without laterals, are listed in the NCPI Air Test Tables, as published in the latest National Clay Pipe Institutes “Low Pressure Air Test for Sanitary Sewers (Procedures and Tables).” The maximum length of a line that may be tested at one time shall be five hundred (500) feet, or the length between any two (2) adjacent manholes, or where otherwise directed by the District Engineer. After completion of the test, the air pressure shall be released slowly through the valve, which is incorporated in the test equipment. Air test plugs shall not be removed until the air pressure is no longer measurable.

D. All necessary test equipment shall be furnished by the Contractor and the Contractor shall conduct all testing at no cost to the District.

3.02 INFILTRATION TEST

A. Prior to testing for infiltration, the ends of the sewer pipe section to be tested shall be cleaned using a Wayne Ball, all pipe shall be capped or plugged to prevent the entrance of water, and pumping of groundwater shall be discontinued for at least three (3) days.

B. Any infiltration discovered before completion and acceptance of the sewer shall be corrected. The sewer shall be examined and the source of infiltration eliminated. Following repairs or replacement as necessary, including backfill and compaction, the subject line shall be retested to assure no infiltration.

3.03 PRESSURE TESTS FOR SEWER FORCE MAINS

Pressure tests for sewer force mains shall be in accordance with Section 15044 except that the allowable leakage shall be zero (0). All leak points shall be located and stopped. All defective pipes, fittings, valves and other appurtenances discovered shall be removed and replaced with sound material and tests repeated until the leakage is zero (0).

3.04 CLOSED-CIRCUIT TELEVISION INSPECTION

A. In addition to the leakage and infiltration tests, closed-circuit television inspections will be conducted by the District. The inspection shall be conducted after all utilities have been installed and the backfill compaction certified, but prior to final paving.

B. All defects and evidence of reverse slope by ponding of water or dips in pipe alignment revealed by the closed-circuit television inspection shall be repaired to the satisfaction of the District Engineer at the Contractors expense.

3.05 VACUUM TESTING OF MANHOLES

Vacuum testing of manholes shall be performed in accordance with Section 03461.

3.06 FINAL ACCEPTANCE

The requirements of this section shall be considered acceptable when each sewer section's air leakage rate is less than the maximum allowed, the television inspection is satisfactory, and the water infiltration rate is zero (0).

END OF SECTION

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SECTION 15044

HYDROSTATIC TESTING OF PRESSURE PIPELINES

PART 1 GENERAL

1.01 DESCRIPTION

This section describes the requirements and procedures for pressure and leakage testing of all pressure mains.

1.02 REFERENCE STANDARDS

The publications listed below form part of this specification to the extent referenced and are referred to in the text by the basic designation only. Reference shall be made to the latest edition of said standards unless otherwise called for:

AWWA C600 Installation of Ductile Iron Water Mains

1.03 RELATED WORK SPECIFIED ELSEWHERE

Section 15041	Disinfection of Pipe
Section 15112	Backflow Prevention

1.04 REQUIREMENTS PRIOR TO TESTING

A. All piping, valves, fire hydrants, services, and related appurtenances shall be installed prior to testing.

B. The pipe trench shall have trench zone backfill placed and compacted with a minimum of 2.5 feet of material over the pipe.

C. All concrete anchor blocks shall be allowed to cure a sufficient time to develop a minimum strength of 2,000 psi before testing.

D. Pressure tests on exposed and aboveground piping shall be conducted only after the entire piping system has been installed and attached to pipe supports, hangers or anchors as shown on the Approved Plans.

E. Steel pipelines shall not be tested before the mortar lining and coating on all pipe lengths within the line have been in place for a minimum of seven(7) days. Cement-mortar lined pipe shall not be filled with water until a minimum of eight hours has elapsed after the last joint has been mortared.

1.05 HYDROSTATIC TESTING AND DISINFECTION OF PIPELINES

Hydrostatic testing of pipelines shall be performed prior to the disinfection operations in accordance with Section 15041.

1.06 CONNECTION TO EXISTING MAINS

Hydrostatic testing shall be performed prior to connections to existing mains. District authorization for connection to the existing system shall be given only on the basis of acceptable hydrostatic, disinfection and bacteriological test results.

PART 2 MATERIALS

2.01 WATER

A. Potable water shall be used for hydrostatic testing of potable water mains when such testing is performed separately from disinfection operations.

B. Potable water shall be supplied by a District approved source. Make-up water for testing shall also be potable water.

C. Well water shall not be used for hydrostatic testing or any other purposes in new or existing pipelines.

2.02 CONNECTIONS

A. Testing water shall be supplied through a metered connection equipped with a backflow prevention device in accordance with Section 15112 at the point of connection to the potable water source used.

B. The Contractor shall provide any temporary piping needed to deliver potable water to the piping that is to be tested.

PART 3 EXECUTION

3.01 GENERAL

A. The Contractor shall provide the District Engineer with a minimum of five (5) working days notice prior to the requested date and time for hydrostatic tests.

B. The Contractor shall furnish all labor, materials, tools, and equipment for testing.

C. Temporary blocking during the tests will be permitted only at temporary plugs, caps or where otherwise directed by the District Engineer.

D. All valves and appurtenances shall be operated during the test period. The test shall be conducted with valves in the open position.

E. At the onset of testing, all valves, air vacuum assemblies, blowoffs, and services shall be monitored for possible leakage and repairs made, if necessary, before the test proceeds. The appurtenances shall be monitored for the duration of testing.

F. For pipe with porous lining, such as cement mortar, the pipe shall be filled with water and placed under a slight pressure for a minimum of two (2) working days prior to the actual hydrostatic test.

3.02 FIELD TEST PROCEDURE

A. Before applying the specified test pressure, care shall be taken to release all air within the pipe and appurtenances to be tested. Air shall be released through services, fire hydrants, air release valves, or other approved locations.

B. A five (5) hour hydrostatic pressure test shall be performed after the pipe and all appurtenances have been installed and after any trench backfill compaction with heavy-duty compaction equipment has been completed. The hydrostatic test pressure shall be 50 psi above the class rating of the pipe at the lowest point in the section being tested and shall be at least equal to the design class of the pipe at the highest point in the line.

C. The test pressure shall be applied and continuously maintained by pumping for a period of four (4) hours. During the pumping phase of the test, the test pressure shall be maintained within 5 psig of the specified test pressure at all times.

D. At the end of the fourth (4th) hour, the pressure shall meet the requirements stated above. Pumping shall then be discontinued for one (1) hour and the drop in pressure shall be recorded. Pumping shall then be resumed to restore the initial test pressure, and the quantity of water pumped into the line shall be accurately measured. This measured quantity shall not exceed that which would result from leakage at the following rates:

1. The allowable leakage for steel (flanged or welded) and ductile iron (flanged) pipe shall be zero.

2. The leakage for polyvinyl chloride (PVC) pipe and for steel or ductile-iron pipes with rubber joints shall be considered as the total amount of water pumped into the pipe system after the fifth (5th) hour of testing. Allowable leakage during the fifth (5th) hour shall be in accordance with AWWA C600-99 and calculated using the following formula:

$$L = \frac{S * D * (P)^{0.5}}{133{,}200}$$

L = testing allowance (gallons / hour)
S = length of pipe tested (feet)
D = nominal diameter of pipe (inches)
P = average test pressure during test (pounds / sq. inch (gage))

3. If leakage exceeds the allowable loss, the leak points shall be located and repaired as required by the District Engineer. All defective pipe, fittings, valves, and other appurtenances discovered shall be removed and replaced with reliable material. Additional disinfection shall be performed as necessary per Section 15041. The hydrostatic test shall be repeated until the leakage does not exceed the rate specified above. All visible leaks shall be similarly repaired.

END OF SECTION

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SECTION 15056

DUCTILE-IRON PIPE AND FITTINGS

PART 1 GENERAL

1.01 DESCRIPTION

This section includes materials and installation of ductile-iron pipe and fittings for potable and recycled water systems. A written request to use Ductile Iron in lieu of CML&C steel must be submitted to the District Engineer and approved in writing.

1.02 REFERENCE STANDARDS

The publications listed below form part of this specification to the extent referenced and are referred to in the text by the basic designation only. Reference shall be made to the latest edition of said standards unless otherwise called for:

ANSI B1.1	Unified Inch Screw Threads
ASTM A193	Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 307	Standard Specification for Carbon Steel Bolts and Studs
ASTM C 150	Standard Specification for Portland Cement
ASTM A 536	Standard Specifications for Ductile Iron Castings
AWWA C104	Cement Mortar Lining for Ductile Pipe and Fittings for Water Mains and Sewer
AWWA C105	Polyethylene Encasement for Ductile Iron Pipe
AWWA C110	Ductile Iron Fittings
AWWA C111	Rubber-Gasket Joints for Ductile Iron Pipe and Fittings
AWWA C115	Flanged Ductile Iron Pipe with Threaded Flanges
AWWA C150	Thickness Design of Ductile Iron Pipe
AWWA C151	Ductile Pipe, Centrifugally Cast
AWWA C153	Ductile Iron Compact Fittings
AWWA C207	Steel Pipe Flanges for Waterworks Service – Sizes 4” through 144”
AWWA C217	Cold-Applied Petroleum Wax Tape Coatings
AWWA C600	Installation of Ductile Iron Water Mains
AWWA C602	Cement-Mortar Lining of Water Pipelines
AWWA C606	Grooved and Shouldered Type Joints

1.03 RELATED WORK SPECIFIED ELSEWHERE

FPUD	Standard Drawings
Section 02223	Trenching, Backfilling and Compacting
Section 03300	Cast-in-Place Concrete
Section 09900	Painting and Coating
Section 15041	Disinfection of Pipe
Section 15044	Hydrostatic Testing of Pressure Pipe

1.04 SERVICE APPLICATION

Ductile-iron pipe shall be used only in specific areas, locations, and uses allowed by the District Engineer.

1.05 QUALITY ASSURANCE

A. The manufacturer of each shipment of pipe shall be required to supply a statement certifying that each lot or load of pipe and fittings has been subjected to and met the tests specified for ductile-iron pipe and fittings per AWWA C110, C111, C115, C150, C151, and C153, as applicable.

B. All pipe shall have a home mark on the spigot end to indicate proper penetration when the joint is made.

C. Ductile-iron pipe shall bear indelible identification markings as required by AWWA C151.

1.06 SUBMITTALS

The following items shall be submitted and reviewed by the District Engineer prior to shipping of ductile-iron pipe and fittings:

A. An affidavit of compliance with AWWA C104, C110, C111 , C115, C150, C151, C153, and the requirements of this specification.

B. Typical joint details.

C. Typical details and description of lining and coating.

D. Calculations supporting selected wall thickness.

E. Calculations demonstrating that each proposed restrained joint arrangement can resist the applied forces.

F. Cathodic protection materials.

1.07 DELIVERY, STORAGE, AND HANDLING

Delivery, storage, and handling of ductile-iron pipe and fittings shall follow the recommendations of AWWA C600 and as specified herein:

A. Handling of pipe shall be performed with lifts, cranes, or other suitable equipment and devices. Slings, hooks, or pipe tongs shall be padded and used in such a manner as to prevent damage to the pipe, linings, and coatings. The pipes shall not be dropped or dragged.

B. During transport, the pipe shall be supported and secured against movement using padded devices in such a manner to prevent damage.

C. Stored pipe shall be protected from damage and kept free from dirt and foreign materials by closing the ends of the pipe. Other pipeline materials shall be protected by appropriate packaging or wrapping. Gaskets shall be stored in a cool location out of direct sunlight. Bolts, nuts, and washers shall be handled and stored in a dry location in a manner that will ensure proper use with respect to types and sizes.

D. Pipe laid out for installation shall be placed on earth berms or timber cradles adjacent to the trench in the numerical order of installation.

E. Maintain plastic end caps on all pipe and fittings in good condition until the pipe is ready to be installed in the trench. Periodically open the plastic end caps and spray clean potable water inside the pipe for moisture control.

F. Under no circumstances shall ropes or other devices be attached through the fitting's interior for handling.

PART 2 MATERIALS

2.01 DUCTILE-IRON

A. General:

1. Ductile-iron pipe and fittings shall be manufactured per AWWA C110, C111, C115, C150, C151, and C153. Gray-iron and cast-iron fittings or flanges shall not be used.

2. Ductile-iron fittings manufactured per AWWA C153 shall be installed on mains 12-inch and smaller only.

3. Joints for ductile-iron pipe and fittings shall be mechanical, flanged, or push-on in accordance with AWWA C110, C111 , and C153.

4. Except as amended herein, or otherwise shown on the Approved Plans, joints for ductile-iron pipe and ductile-iron fittings shall have a pressure rating equal to or greater than the adjacent piping.

5. Joints in buried piping may be of the push-on, flanged or mechanical- joint type per AWWA C111 except where particularly specified on the Approved Drawings.

6. Joints that are aboveground, within structures, or submerged shall be flanged unless otherwise shown on the Approved Plans.

B. Unless otherwise specified, ductile-iron flanges shall be in accordance with AWWA C115, rated at a working pressure of 250 psi. Where required in order to connect to the flanges of 250 psi butterfly valves, or as otherwise shown on the approved plans, ductile-iron flanges shall be compatible with AWWA C207, Class "E".

Maximum working pressure of flanges shall as specified in AWWA or ASME/ANSI. Flanges shall be integrally cast per AWWA C110 or shop-threaded per AWWA C115. Flanges shall be solid. Hollow-back flanges are not permitted. Gray-iron or cast-iron flanges are not permitted. Threading of flanges in the field is not permitted.

Where threaded flanges are used, the pipe or spool piece to which they are connected will be hydrostatically tested in the presence of the District Engineer prior to installation. The pipe section or spool piece shall be hydrostatically tested for 15 minutes at the pressure rating of the flanges. No leaks shall be permitted.

C. Plain ends shall conform to the requirement of AWWA C151 and to the dimensions included within AWWA C110 to accept a mechanical joint, push-on joint, flanged coupling adaptor, flexible coupling, or grooved coupling.

D. The exterior surfaces of all pipe and fittings shall be factory coated with a minimum one (1) mil thick petroleum asphaltic material per AWWA C110 and C151.

E. All pipe and fittings shall be cement-mortar lined in accordance with AWWA C104, using the double thickness requirements indicated in said standard, Type II or Type V Portland cement per ASTM C 150 shall be used.

2.02 GASKETS

A. Mechanical joint rubber gasket configuration and materials shall comply with AWWA C111, and according to the applicable joint type and pressure rating of the piping system.

B. Flange gaskets shall be 1/8-inch thick acrylic or aramid fibers bound with nitrile for all sizes of pipe. Gaskets shall be full-face type with pre-punched holes. Ring gaskets extending to the inner edge of the bolt circumference may be used only upon approval of the District Engineer.

C. Insulating Sections. Where a metallic nonferrous pipe or appurtenance is connected to ferrous pipe or appurtenance, an insulating flange gasket kit shall be provided. Each insulating gasket shall have a pressure rating equal to or exceeding the connecting pipes.

D. Push-on joint rubber gaskets shall be per AWWA C111.

E. If organic solvents or petroleum products are encountered during the course of the work, alternate gasket materials or joint treatment may be required by the District Engineer.

2.03 MECHANICALLY RESTRAINED JOINTS

Mechanically restrained joints shall have boltless positive lock ring type joints as manufactured by U.S. Pipe TR Flex, American Pipe Lok Ring, Megalug or approved equal. The design shall permit

disassembling of the joint for repair and maintenance. External type harnesses and internal type restraints will not be allowed.

2.04 BOLTS AND NUTS FOR FLANGES

Bolts and nuts shall be as indicated below and shall be selected from the Approved Materials List.

A. Stainless steel bolts and nuts shall be used for submerged flanges. Bolts and nuts shall be Type 316 stainless steel conforming to ASTM A193, Grade B8M for bolts, and Grade 8M for nuts.

B. All bolt heads and nuts shall be hexagonal, except where special shapes are required. Bolts shall be of such length that not less than 1/4-inch or more than 1/2-inch shall project past the nut in tightened position.

2.05 PAINTING AND COATING

A. Buried ductile-iron pipe shall receive an asphaltic coating in accordance with AWWA C115.

B. Materials for coating of pipe and fittings located above ground and in structures shall be in accordance Section 09900.

C. Materials for coating buried mechanical joint and hardware shall be in accordance Section 13110.

2.06 IMPORTED GRANULAR MATERIAL FOR PIPE AND TRENCH ZONES

Imported granular material for use in pipe and trench zones shall be in accordance with Section 02223.

2.07 CONCRETE

Concrete for thrust and anchor blocks shall be in accordance with Section 03300.

2.08 POLYETHYLENE ENCASEMENT

Polyethylene encasement shall consist of a tube of at least 8 mils thickness and be selected from the Approved Materials List. Plastic adhesive tape for polyethylene encasement shall be 2-inches wide and be selected from the Approved Materials List.

2.09 WARNING/IDENTIFICATION TAPE

Use marking tape consisting of one layer of aluminum foil laminated between two (2) colored layers of inert plastic film. The lamination bond shall be strong enough that the layers can not be separated by hand. Tape shall be a minimum of 5 mils thick and 6 inches wide. Elongation shall be a minimum of 600%. Tape shall bear a continuous, printed, message every 16 to 36-inches warning of the installation buried below. Tape shall be selected from the Approved Materials List.

PART 3 EXECUTION

3.01 GENERAL

At all times when the work of installing pipe is not in progress, including worker break times, ends of the pipe shall be closed with a vermin-proof and child-proof cap or plug. Do not permit trench water to enter the pipe. Do not place tools, clothing, or other materials in the pipe. The Contractor shall maintain the interior of the pipe in a sanitary condition free from foreign materials.

3.02 TRENCHING, BACKFILLING AND COMPACTING

Trenching, backfilling and compacting shall be performed in accordance with Section 02223.

3.03 DEWATERING

A. The Contractor shall provide and maintain at all times during construction ample means and devices to promptly remove and dispose of all water from any source entering trench excavations or other parts of the work in accordance with Section 02223. Any damage caused by flooding of the trench shall be the Contractor's responsibility.

B. Dewatering shall be performed by methods that will maintain a dry excavation, preservation of the final lines and grades and protection of all utilities. If flooding of the trench does occur, the Contractor shall immediately dewater and restore the trench. Damaged or altered pipeline appurtenances or trench materials shall be repaired or replaced as directed by the District Engineer.

3.04 PIPE INSTALLATION

A. When the work requires and the size of the pipe allows entry of personnel into the pipe, the Contractor shall comply with all Federal and State regulations for confined space entry. Work inside pipelines shall not be undertaken until all the tests and safety provisions of the Code of Federal Regulations 1910.146, and the General Industry Safety Orders of the California Code of Regulations, Title 8, Section 5159 for confined space entry have been performed and the area is verified as safe to enter .

B. The Contractor shall furnish and install all pipe, specials, fittings, closure pieces, valves, supports, bolts, nuts, gaskets, jointing materials, and all other appurtenances as shown on the Approved Plans and as required to provide a complete and workable installation. Install pipe in the trench as follows:

1. Inspect each pipe and fitting before lowering the pipe or fitting into the trench. Inspect the interior and exterior protective coatings. Patch damaged areas in the field with material recommended by the protective coating manufacturer. Thoroughly clean the ends of the pipe. Remove foreign matter and dirt from inside of the pipe and keep pipe clean during and after installation.

2. Install pipe according to the manufacturer's approved order of installation. Install pipes uphill if the grade exceeds 10%. Lower the pipe onto the bedding at the proper lines and grades.

3. The manufacturer's printed installation guide outlining the radius of curvature that can be negotiated with pipe sections of various lengths shall be followed, except they shall not exceed the deflections allowed in AWWA C600 according to joint type. Combined deflections at rubber gasket or flexible coupling joints shall not exceed that recommended by the manufacturer.

4. The pipe shall have firm bearing along its full length, and bell holes shall be provided at each joint to permit visual inspection of the joint and prevent the pipe from being supported by the bell end or coupling.

C. Pipe Assembly

1. Push-On Type: Assemble the pipe joint using a lubricant selected from the Approved Materials List. Insert the spigot end into the bell or coupling to the proper insertion mark. Check that the elastomeric ring has not left the groove during assembly by passing a feeler gauge around the completed joint. Drive spigot ends of the pipe into bell ends in accordance with the manufacturer's recommendations. Stabbing shall not be permitted.

2. Mechanical Joint Type: Assembly of mechanical joint fittings shall be in accordance with the manufacturer's recommendations regarding installation.

D. During installation operations, do not place tools, clothing, or other materials in the pipe.

E. When pipe installation is not in progress, including worker break times, ends of the pipe shall be closed with a vermin-proof and child-proof cap or plug. Do not permit trench water, animals, or foreign material to enter the pipe.

3.05 POLYETHYLENE ENCASEMENT

Polyethylene encasement shall be used for the buried installation of ductile iron pipe and fittings and shall be installed in accordance with AWWA C105, Method A.

3.06 FLANGED PIPE AND FITTINGS

Flanged connections shall be installed where indicated on the Approved Drawings.

A. Bolt holes shall straddle the horizontal and vertical centerlines.

B. The bolts, nuts and flange faces shall be thoroughly cleaned by wire brush prior to assembly.

C. Bolts and nuts shall be lubricated with a District-approved anti-seize compound.

D. Nuts shall be tightened in an alternating "star" pattern to the manufacturer's recommended torque.

E. Coat the exterior of exposed flanges, bolts and nuts located aboveground or within vaults in accordance with Section 09900.

3.07 MECHANICAL JOINT CONNECTIONS

A. Install mechanical joint connections per AWWA C600 and the manufacturer's recommendations.

B. Prior to installation of the mechanical joint, clean the socket and plain end of the pipe. Lubricate both the gasket and plain end of the pipe with an approved lubricant per AWWA C111 immediately prior to slipping the gasket onto the plain end of the pipe.

C. Tighten the bolts to the normal range of bolt torque per the manufacturer's recommendations and AWWA C600, Table 3.

3.08 COUPLINGS FOR DUCTILE-IRON PIPE

Mechanical type flexible joints shall be installed where shown on the Approved Drawings. Grooved couplings shall be used in vaults and above ground. Flexible couplings may be used, where indicated on the drawings, below ground, but may also be used above ground with restrained joints. Flanged coupling adapters shall be used for buried pipelines, where allowed by the District Engineer.

A. Grooved joint couplings shall be installed per AWWA C606.

B. Flanged coupling adapters, where allowed by the District Engineer, shall be installed per the manufacturer's recommendations.

C. Flexible couplings shall be installed per the manufacturer's recommendations.

D. All couplings for ductile-iron pipe shall be shop-coated in accordance with Section 09900.

3.09 CONCRETE

Concrete thrust and anchor blocks shall be installed in accordance with Section 03300 and the Standards Drawings. Prior to filling the pipeline with water, refer to Section 03300 for the minimum concrete curing time required.

3.10 WARNING/IDENTIFICATION TAPE

After the pipe zone and the first 12-inches in the trench zone have been backfilled and compacted, place the marking tape on the compacted backfill and center over the pipe. Run tape continuously along the trench and tie ends of tape together. Wrap marking tape around valve box extension pipes and continue along pipe.

3.11 DISINFECTION AND BACTERIOLOGICAL TESTING

Disinfection, bacteriological testing, and flushing shall be performed in accordance with Section 15041.

3.12 HYDROSTATIC TESTING

Field hydrostatic testing shall be performed in accordance with Section 15044.

END OF SECTION

SECTION 15057

COPPER TUBING, BRASS AND BRONZE PIPE FITTINGS

PART 1 GENERAL

1.01 DESCRIPTION

This section includes materials and installation of copper tubing, brass and bronze pipe fittings and appurtenances. Pipe fittings must comply with California State Law requirements for “lead free” plumbing (Statue: CH&SC 116875).

1.02 REFERENCE STANDARDS

The publications listed below form part of this specification to the extent referenced and are referred to in the text by the basic designation only. Reference shall be made to the latest edition of said standards unless otherwise called for:

ANSI B1. 1	Unified Inch Screw Threads
ANSI B1.2	Gauges and Gauging for Unified Inch Screw Threads
ANSI B1.20.1	Pipe Threads, General Purpose (Inch)
ANSI B16.24	Cast Copper Alloy Pipe Flanges and Flanged Fittings
ASTM A 307	Carbon Steel Bolts and Studs
ASTM B 43	Seamless Red Brass Pipe, Standard Sizes
ASTM B 62	Composition Bronze or Ounce Metal Castings
ASTM B 88	Seamless Copper Water Tube
ASTM B 88M	Seamless Copper Water Tube [Metric
AWWA C800	Underground Service Line Valves and Fittings

1.03 RELATED WORK SPECIFIED ELSEWHERE

FPUD	Standard Drawings
Section 02223	Trenching, Backfilling and Compacting
Section 05550	Misc. Metals
Section 15041	Disinfection of Pipe
Section 15044	Hydrostatic Testing of Pressure Pipe

PART 2 MATERIALS

2.01 COPPER TUBING

Copper tubing shall conform to the requirements of ASTM B 88 Type K. Copper tubing up to 1-inch diameter shall be soft. Copper tubing 2-inches in diameter may be soft when pressures are 150psi and less. Components shall be selected from the Approved Materials List in accordance with the Standard Drawings.

2.02 BRASS PIPE, NIPPLES, AND FITTINGS

Threaded nipples, brass pipe and fittings shall conform to ASTM B 43, regular wall thickness. Threads shall conform to ANSI B1.20. 1. Fittings shall be compression type. Brass pipe shall not contain lead material.

2.03 BRONZE APPURTENANCES

A. Corporation stops, curb stops, meter and angle meter stops, meter flange adapters, and bronze-bodied service saddles shall be selected from the Approved Materials List in accordance with the Standard Drawings.

B. Fittings shall be threaded type.

C. All items specified herein shall be manufactured of bronze conforming to ASTM B 62.

D. Service saddles shall be the double strap type. Service saddles shall be used on all service and appurtenance connections on PVC piping. For piping materials other than PVC, service and appurtenance connections shall be performed in accordance with the Approved Drawings.

2.04 BOLTS AND NUTS FOR FLANGES

Bolts and nuts shall be in accordance with the Approved Materials List.

2.05 WARNING/IDENTIFICATION TAPE

Use marking tape consisting of one (1) layer of aluminum foil laminated between two (2) colored layers of inert plastic film. The lamination bond shall be strong enough that the layers can not be separated by hand. Tape shall be a minimum of 5 mils thick and 6 inches wide. Elongation shall be a minimum of 600%. Tape shall bear a continuous, printed, message every 16 to 36-inches warning of the installation buried below. Tape shall be Terra Tape, Linetec, or District approved equal.

PART 3 EXECUTION

3.01 COPPER TUBING AND FITTINGS

A. Trenching, bedding, backfilling and compacting shall be performed in accordance with Section 02223 and the Standard Drawings. Provide a minimum cover of 30-inch below finished street grade.

B. Cut tubing true and square and remove burrs.

C. Bends in soft copper tubing shall be long sweep. Shape bends with shaping tools. Form bends without flattening, buckling, or thinning the tubing wall at any point.

D. Assemble copper tubing and fittings per the manufacturer's recommendation in accordance with the Standard Drawings.

E. For water services 2-inches and less, Corp Stops shall be insulated type and selected from the Approved Material List.

3.02 SERVICE SADDLES

A. On PVC and Ductile-iron Pipe

1. Service saddles shall be located a minimum of 24-inch from any pipe joint or fittings.

2. Service saddles for connections shall be located a minimum of 24-inch from other saddles. Additionally, multiple service saddles for connections that are installed on the same side of a single pipe length shall be alternately staggered between 35° and 55° to prevent a weak plane in the pipe.

3. The surface of the pipe shall be clean and all loose material shall be removed to provide a hard, clean surface.

4. The service saddle shall be tightened in accordance with the manufacturer's recommendations to ensure a tight seal, using care to prevent damage or distortion of the service saddle or corporation stop due to over-tightening.

5. The tap into the pipe shall be made in accordance with the pipe manufacturer's recommendation. Tapping tools and shell cutters with internal teeth or double slots that will retain the coupon shall be used.

6. Service Saddles shall be the Double-Strap type and selected from the Approved Materials List.

B. Welded Coupling on Steel Pipe

1. Service saddles shall be located a minimum of 24-inch from any pipe joint or fittings.

2. Service saddles for connections shall be located a minimum of 24-inch from other saddles. Additionally, multiple service saddles for connections that are installed on the same side of a single pipe length shall be alternately staggered between 35° and 55° to prevent a weak plane in the pipe.

3. The surface of the pipe shall be clean and all loose material shall be removed to provide a hard, clean surface.

4. Shall be welded steel Class 3000

3.03 WARNING/IDENTIFICATION TAPE

After the pipe zone and the first 12-inches in the trench zone have been backfilled and compacted, place the marking tape on the compacted backfill and center over the pipe. Run tape continuously along the trench and tie ends of tape together. Wrap marking tape around valve box extension pipes and continue along pipe.

3.04 DISINFECTION AND BACTERIOLOGICAL TESTING

Disinfection, bacteriological testing, and flushing shall be performed in accordance with Section 15041.

3.05 HYDROSTATIC TESTING

Field hydrostatic testing shall be performed in accordance with Section 15044.

END OF SECTION

SECTION 15062

POLYVINYL CHLORIDE (PVC)
GRAVITY SEWER PIPE AND FITTINGS

PART 1 GENERAL

1.01 DESCRIPTION

This section designates the requirements for the manufacture and installation of polyvinyl chloride, abbreviated PVC, gravity sewer pipe to be furnished and installed by the Contractor, at the location and to the lines and grades shown on the Plans as herein specified.

1.02 REFERENCE STANDARDS

The publications listed below form part of this specification to the extent referenced and are referred to in the text by the basic designation only. Reference shall be made to the latest edition of said standards unless otherwise called for:

ASTM D1784	Rigid PVC Compounds
ASTM D2321	Underground Installation of Flexible Thermoplastic Sewer Pipe
ASTM D2412	Pipe Stiffness Test
ASTM D2564	Solvent Cements for PVC Pipe Fittings
ASTM D3034	PVC Sewer Pipe and Fittings (4" to 15")
ASTM D3212	Joints for Drain and Sewer Plastic Pipe Using Elastomeric Seals
ASTM F477	Elastomeric Gaskets for Joining Plastic Pipe
ASTM F679	PVC Large Diameter Gravity Sewer Pipe and Fittings (18" to 27")
UNI-B-5	Uni Bell Recommended Practice for the Installation of PVC Sewer Pipe

1.03 RELATED WORK SPECIFIED ELSEWHERE

FPUD	Standard Drawings
Section 02223	Trenching, Backfilling and Compacting
Section 03461	Precast Concrete Manholes
Section 15043	Testing of Gravity Sewer

1.04 SUBMITTALS

The Contractor shall furnish submittals in accordance with Section 1 General Conditions. Submittals are required for the following:

A. Submit Shop Drawings, material lists, manufacturer's literature and catalog cuts and other information.

B. An affidavit from the pipe manufacturer including compliance with requirements of the Plans and Specifications shall be delivered with the pipe.

PART 2 MATERIALS

2.01 PVC PIPE

A. PVC gravity sewer pipe shall be made of PVC plastic having a cell classification of 12454-B, 13364-A, or 13364-B as defined in ASTM D1784. PVC gravity sewer pipe, fittings, coupling and joints, 4-inch through 15-inch, shall be manufactured in conformance with the requirements of ASTM D3034, SDR 35 and shall have gasketed joints. All pipe shall be of solid wall construction with smooth interior and exterior surfaces.

B. Any fittings shall also be made of PVC plastic and have a cell classification of 12454-B, 12454-C, or 13343-C as defined in ASTM D1784. PVC gravity sewer pipe, fittings, coupling and joints, 18-inch through 21-inch, shall be manufactured in conformance with the requirements of ASTM F679 with T-1 wall thickness and shall have gasketed joints. All pipe shall be of solid wall construction with smooth interior and exterior surfaces.

C. The minimum pipe stiffness for both small diameter and large diameter PVC gravity sewer pipe shall be 46 psi according to ASTM D2412.

2.02 JOINING SYSTEM

A. The pipe shall be jointed with an integral bell gasketed joint that meets the requirements of ASTM D3212. The gasket shall be manufactured from a synthetic elastomer and factory installed in the belled end of the pipe. Gasket shall conform to ASTM F477.

B. All pipe shall have a homemark on the spigot end to indicate proper penetration when the joint is made. The socket and spigot configurations for fittings and couplings shall be compatible to those used for the pipe.

2.03 CERTIFICATION

Pipe, fittings, and couplings shall meet the requirements of the section titled “Requirements” of ASTM D3034 SDR 35 (4-inch through 15-inch) and ASTM F679 (18-inch through 27-inch). During production of the pipe, the manufacturer shall perform the specified tests for each pipe marking. A certification by the manufacturer indicating compliance with specification requirements shall be delivered with the pipe. The certification shall include the test result data. Pipe which is not installed within 120 days of latest test shall not be used without prior approval of the District Engineer.

2.04 WARNING/IDENTIFICATION TAPE

Use marking tape consisting of one layer of aluminum foil laminated between two colored layers of inert plastic film. The lamination bond shall be strong enough that the layers can not be separated by hand. Tape shall be a minimum of 5 mils thick and 6-inches wide. Elongation shall be a minimum of 600%. Tape shall bear a continuous, printed, message every 16 to 36-inches warning of the installation buried below. Tape shall be selected from the Approved Materials List.

PART 3 EXECUTION

3.01 PIPE LENGTHS

Standard laying lengths shall be 20-feet and 12.5-feet with the manufacturer's option to supply up to 15% random lengths. Combined horizontal and vertical deflections at PVC gravity sewer pipe shall not exceed that recommended by the manufacturer (the maximum total deflection allowed shall be three (3) degrees). Any deflection of the pipe shall be accomplished by bending the pipe along its entire length in the trench and not by deflection at the joints.

3.02 MARKING

All pipe, fittings, and couplings shall be clearly marked at an interval not to exceed 5-feet as follows:

Nominal Pipe Diameter
PVC cell classification
Company, plant, shift, ASTM, SDR, and date designation
Service designation or legend

For fittings and couplings, the SDR designation is not required.

3.03 EARTHWORK

A. Excavation and backfill, including the pipe bedding, shall conform to the provisions of Section 02223, Trenching, Backfilling and Compacting, except as herein modified.

B. Crushed Rock and Gravel: Crushed rock shall be the product of crushing rock or gravel. Fifty percent of the particles retained on a 3/8-inch sieve shall have their entire surface area composed of faces resulting from fracture due to mechanical crushing. Not over five (5) percent shall be particles that show no faces resulting from crushing. Less than ten (10) percent of the particles that pass 3/8-inch sieve and are retained on the No. 4 sieve shall be water worn particles. Gravel shall not be added for crushed rock.

1. Gravel shall be defined as particles that show no evidence of mechanical crushing, are fully waterworn, and are rounded. For pipe bedding, where gravel is specified, crushed rock may be substituted or added.

2. Where crushed rock or gravel is specified in the bedding details on the Plans or in the Specifications, the material shall have the following gradations:

Sieve Size	3/4-Inch Max Crushed Rock % Passing
1"	100
3/4"	90 - 100
½"	55 - 90
3/8"	20 - 55
No. 4	0 - 10
No. 8	---

C. Pipe Bedding: Crushed rock shall be used for pipe bedding and shall be compacted to obtain a relative density of 90% unless otherwise specified. The thickness of the pipe bedding shall be a minimum of 6-inches. The pipe bedding shall be placed over the full width of the trench.

D. Backfill Within Pipe Zone: Crushed rock shall be placed and compacted within the pipe zone from the bottom of the pipe to 12-inches above the top of the pipe outside diameter. The crushed rock shall be compacted to obtain a relative density of 90% unless otherwise specified.

3.04 GENERAL INSTALLATIONS PROCEDURES AND WORKMANSHIP

A. PVC pressure pipe and fittings shall be installed per ASTM D2321, Uni Bell pamphlet Uni-B-5, and the manufacturer's recommendations.

B. Proper care shall be used to prevent damage in handling, moving, and placing the pipe. The Contractor shall unload the pipe by mechanical means such as a crane or backhoe, or by rope and skids, as recommended by the manufacturer. In using skids, pipes must be prevented from striking other pipe. Dropping pipe from truck will not be permitted.

C. All pipe shall be laid without break, upgrade from structure to structure, with the bell ends of the pipe upgrade. Pipe shall be laid to the line and grade given so as to form a close concentric joint with the adjoining pipe and prevent sudden offsets of the flow line. The interior of the pipe shall be cleaned of all dirt and superfluous materials of all description immediately prior to installing the pipe. The Contractor shall wipe the mating surfaces of the pipe to be joined clean of all dirt and foreign matter and apply an approved lubricant. The spigot end shall be inserted to the proper depth of the socket as indicated by the home mark.

D. Laying tolerances for the installed pipe shall not vary greater than 0.3-foot horizontally, or greater than 0.1-foot vertically from the alignment and elevations shown on the Approved Drawings.

3.05 BRANCHES

A. PVC wyes, and other types of branches shall be furnished and installed along with PVC pipe as is called for on the Plans. The longitudinal barrel of branch fittings, to be placed in line and grade with PVC sewer mains, shall be of the same diameter, quality, and type as specified herein for sewer installations, and shall conform to the applicable provisions set forth for PVC gravity sewer pipe. Unless otherwise specified, the branch of wye fittings shall be inclined upward at an angle not greater than 45 degrees from a horizontal line. No wye shall be placed closer than 5-feet in the downstream side to the centerline of any structure. Also no two wyes or tees shall be laid back to back. There shall be a minimum of 3-feet between each branch fitting.

B. The Contractor shall place a support of grade crushed rock or gravel under every wye branch when installed.

3.06 CONNECTIONS TO EXISTING SEWER

All connections into existing sewer lines shall be made by installing a pvc wye with stainless steel couplers.

3.07 MANHOLES

Connection of PVC sewer pipe to the manhole shall be water tight. The connection shall be made with a gasket plastic manhole coupling in accordance with Section 03461 and the Standard Drawings.

3.08 PREVENTING FOREIGN MATTER FROM ENTERING THE PIPE

At all times when pipe laying is not in progress, the open end of the pipe shall be closed with a tight-fitting cap or plug to prevent the entrance of foreign matter into the pipe. These provisions shall apply during the noon hour as well as overnight. Under no circumstances shall the pipeline be used as a drain for removing water which has infiltrated into the trench. The Contractor shall maintain the inside of the pipe free from foreign materials and in a clean and sanitary condition until its acceptance by the Owner.

3.09 CLEANING

Before testing, each pipe shall be thoroughly cleaned from manhole to manhole with a sewer wayne ball. All debris and trash shall be removed from each manhole.

3.10 TEST FOR LEAKAGE AND INFILTRATION

The pipe, and other appurtenances shall be tested for leakage and infiltration in accordance with Section 15043, Testing of Gravity Sewer.

3.11 MANDREL TEST

A. Following the completion of the required testing, the placement and densification of backfill, and the installation of all utilities, and prior to the placing of the permanent paving, all PVC sewer pipe shall be cleaned and then mandrelled, to measure for obstructions (deflections, joint offsets, and lateral pipe intrusions) in accordance with the requirements of the Standard Specifications for Public Works Construction (latest edition) Section 306-1.2.12. A rigid mandrel, with a circular cross section having a diameter of at least 95% of the specified inside diameter, shall be pulled through the pipe by hand. The minimum length of the circular portion of the mandrel shall be equal to the nominal diameter of the pipe.

B. Obstructions encountered by the mandrel shall be corrected by the Contractor. All material, equipment, and labor to perform the test shall be provided by the Contractor at no cost to the District.

END OF SECTION

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SECTION 15064

PVC PRESSURE PIPE
(AWWA C900)

PART 1 GENERAL

1.01 DESCRIPTION

This section includes materials, installation, and testing of polyvinyl chloride (PVC) pressure pipe conforming to AWWA C900. Size range is 4-inches through 12-inches. PVC pipe may only be used by permission of the District Engineer in areas of corrosive soil. A written request to use PVC in lieu of CML&C steel must be submitted to the District Engineer and approved in writing.

1.02 PIPE IDENTIFICATION SYMBOLS

Interpret pipe identification symbols used on the Drawings as follows: PVC-8"-200 designates type of pipe (polyvinyl chloride); nominal pipe size (8-inches); and working pressure rating (Class 200).

1.03 REFERENCE STANDARDS

The publications listed below form part of this specification to the extent referenced and are referred to in the text by the basic designation only. Reference shall be made to the latest edition of said standards unless otherwise called for:

ASTM D1784	Standard Specification for Rigid Polyvinyl Chloride (PVC) Compounds and Chlorinated Polyvinyl Chloride (CPVC) Compounds
ASTM A307	Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A563	Standard Specification for Carbon and Alloy Steel Nuts
ASTM B62	Standard Specification for Composition Bronze or Ounce Metal Castings
ASTM D1248	Standard Specification for Polyethylene Plastics Extrusion Materials For Wire and Cable
AWWA C110	Ductile-Iron and Gray-Iron Fittings, 3-inch through 48-inch, For Water and Other Liquids
AWWA C111	Rubber-Gasket Joints For Ductile-Iron Pressure Pipe and Fittings
AWWA C153	Ductile-Iron Compact Fittings, 3-inch through 16-inch, For Water and Other Liquids
AWWA C900	Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4-inch through 12-inch for Water Distribution

1.04 RELATED WORK SPECIFIED ELSEWHERE

FPUD	Standard Drawings
Section 02223	Trenching, Backfilling, and Compacting
Section 03300	General Concrete Construction
Section 09900	Painting and Coating
Section 15041	Disinfection of Piping
Section 15044	Pressure Testing of Piping

1.05 SUBMITTALS

A. Submit shop drawings in accordance with Section 1 General Conditions.

B. Provide affidavit of compliance with AWWA C900.

C. Submit copies of the following required tests conducted on the project pipe by the manufacturer:

1. Quick-burst strength of pipe and couplings.
2. Flattening resistance of pipe.
3. Record of additional tests after test sample failure.

D. Submit manufacturer's literature on ductile iron fittings conforming to AWWA C110 including dimensions, thickness, weight, coating, lining, and a statement of inspection and compliance with the acceptance tests of AWWA C110.

E. Submit manufacturer's literature on ductile iron fittings conforming to AWWA C153 including dimensions, thickness, weight, coating, and lining. Submit certificate of compliance with AWWA C153. Include legible engineering analysis sealed by a registered professional engineer or test results confirming the hydrostatic design in accordance with Section 53-5.3 of AWWA C153 for each size and configuration of fitting to be supplied. Submit results of foundry tests required by AWWA C153 including chemical analysis per Section 53-13.

F. Submit dimensions of push-on joints and other joints which do not conform to rubber-gasket joints in accordance with AWWA C111.

G. Submit manufacturer's catalog data and descriptive literature for high deflection couplings, repair couplings, tracer wire, marking tape, and miscellaneous piping materials.

1.06 INSPECTION AND FIELD VERIFICATION

A. The District Engineer may inspect materials, productions, and testing at manufacturer's plant.

B. Where new pipelines are to be connected to existing waterlines of the District, the Contractor shall verify in the field the location, elevation, pipe material, pipe outside diameter, and any other characteristics of the existing waterline before proceeding with the pipe installation. This field verification shall be performed in the presence of the District Engineer.

PART 2 MATERIALS

2.01 PVC PIPE

Pipe shall be polyvinyl chloride (PVC) conforming to AWWA C900 with material cell classification 12454-8 per ASTM D 1784. Provide standard pipe having integral bell and spigot with elastomeric gasket and cast iron equivalent outside diameter. Provide pipe in standard 20-foot laying lengths. Straight pipe sections with plain ends for use with high deflection couplings are not available. Random lengths will not be permitted. Provide Class 200 pressure rating or as shown on the Drawings.

2.02 HIGH DEFLECTION COUPLINGS

High Deflection couplings shall be used only with the approval of the District Engineer. Provide polyvinyl chloride (PVC) or ductile iron (DI) couplings with twin elastomeric gaskets which allow 2 degrees of deflection at each gasket for a total of 4 degrees per coupling. Provide couplings for cast iron equivalent outside diameter. Couplings shall be selected from the Approved Materials List.

2.03 CLOSURE/REPAIR COUPLINGS

Provide polyvinyl chloride (PVC) couplings with twin elastomeric gaskets which are designed to connect plain ends of straight pipe. Provide couplings for cast iron equivalent outside diameter and Class 200 pressure rating. Do not deflect pipe in these couplings. Closure/Repair Couplings shall be selected from the Approved Materials List.

2.04 FITTINGS

A. Provide ductile iron fittings conforming to AWWA C110 with a minimum rated working pressure of 350 psi. Provide fittings with bells and gaskets specifically designed for cast iron equivalent outside diameter PVC pipe. Use mechanical joint fittings or fittings with bells and gasket ends.

B. Compact ductile iron fittings shall conform to AWWA C153 with a minimum rated working pressure of 350 psi. Provide fittings constructed of Grade 70-50-05 ductile iron having a minimum weight equal to the weight tabulated in AWWA C153. Provide fittings with bells and gaskets specifically designed for cast iron equivalent outside diameter PVC pipe. Use mechanical joint fittings or fittings with bells and gasket ends conforming to the dimensional values of AWWA C111. Mechanical joint glands shall be Grade 70-50-05 ductile iron and cast in one continuous ring. Fittings with repaired defects are not acceptable and will be rejected.

2.05 LINING AND COATING FOR FITTINGS

Line interior of fittings per Section 15056. Provide protective coatings per section 15056 and section 13110.

2.06 FLANGES

Flanges on ductile iron fittings shall conform to AWWA C110 or ANSI B16.42 Class 150. Refer to Section 15056.

2.07 BOLTS, NUTS AND GASKETS FOR FLANGES

A. Provide stainless steel Type 316L bolts and nuts for buried flanges and 307 grade b cad plated carbon steel for above ground, unless otherwise specified on the plans or approved by the District Engineer.

B. Provide washers for each nut. Washers shall be of the same material as the nuts.

C. Gaskets shall be asbestos-free, drop-in ring type, 1/16-inch or 1/8-inch thick, and shall be acrylic or aramid fiber bound with nitrile. Gaskets shall be suitable for a water pressure of 500 psi at a temperature of 400ºF. Select materials from Approved Materials List.

2.08 OUTLETS

A. For outlets 2-inches and smaller with working pressures 150 psi or less, attach a service saddle and corporation stop to the pipe. Provide service saddles with full width, cast bronze bodies conforming to ASTM B 62, O-ring gaskets, and iron pipe threads. Provide Type 304 stainless steel double band straps with four bolts or a single wide strap with four bolts. All stainless steel shall be fully passivated for enhanced corrosion resistance. All saddles shall be pre-sized at the factory for installation on cast iron equivalent outside diameter PVC pipe conforming to AWWA C900. Service saddles shall be selected from the Approved Materials List

B. For outlets 3-inches and larger, use a ductile iron tee with a flanged outlet.

2.09 FLEXIBLE PIPE COUPLINGS

Flexible pipe couplings shall be selected from the Approved Materials List.

2.10 FLANGE COUPLING ADAPTERS

Flange coupling adapters shall be selected from the Approved Materials List.

2.11 TRACER WIRE- METALLIC

Use AWG No.8 stranded copper wire with high molecular weight polyethylene (HMW/PE) insulation specifically designed for direct burial in corrosive soil or water. Polyethylene insulation shall conform to ASTM D 1248, Type 3, Class C, Grade 5. Wires with cut or damaged insulation are not acceptable and replacement of the entire wire which has been damaged will be required at the Contractor's expense. All tracer wire shall be tested and verified by the District Engineer.

2.12 WARNING/IDENTIFICATION

Use marking tape consisting of one layer of aluminum foil laminated between two colored layers of inert plastic film. The lamination bond shall be strong enough that the layers can not be separated by hand. Tape shall be a minimum of 5 mils thick and 6-inches wide. Elongation shall be a minimum of 600%. Tape shall bear a continuous, printed, message every 16 to 36-inches warning of the installation buried below. Tape shall be selected from the Approved Materials List.

2.13 MARKER POSTS

When pipeline is located outside of paved street, provide marker posts for buried pipelines at 500 feet on center or as directed by the District Engineer. Use 6-inch diameter schedule 40 steel pipe, filled with cement grout and painted white with blue stenciled lettering indicating “WATER.”. See FPUD Standard Detail for Guard Posts.

PART 3 EXECUTION

3.01 PRODUCT MARKING

Legibly mark pipe in blue at 5-foot intervals and each coupling to identify the nominal pipe size, OD base, PVC, dimension ratio number and pressure class, AWWA C900, and the seal of the testing agency that verified the suitability of the material for potable water service.

3.02 DELIVERY AND TEMPORARY STORAGE OF PIPE

A. Ship, store, and place pipe at the storage yard or installation site by supporting the pipe uniformly. Avoid scratching the pipe surface. Do not stack higher than 4 feet nor stack with weight on bells. Cover to protect from sunlight.

B. Do not install pipe that is gouged or scratched forming a clear depression.

C. Do not install pipe contaminated with a petroleum product (inside or outside).

D. Do not install any pipe that shows evidence of exposure to sunlight, age, surface deterioration, or other physical damage. The decision of the District Engineer shall be final as to the acceptability of the pipe to be installed.

3.03 HANDLING OF PIPE

Lift pipes with mechanical equipment using wide belt slings or a continuous fiber rope which avoids scratching the pipe. Do not use cable slings or chains. Pipes up to 12-inches in diameter may be lowered by rolling on two ropes controlled by snubbing. Pipes up to 6-inches in diameter can be lifted by hand.

3.04 PREVENTING FOREIGN MATTER FROM ENTERING THE PIPE

At all times when pipe laying is not in progress, the open end of the pipe shall be closed with a tight-fitting cap or plug to prevent the entrance of foreign matter into the pipe. These provisions shall apply during the noon hour as well as overnight. In no event shall the pipeline be used as a drain for removing water which has infiltrated into the trench. The Contractor shall maintain the inside of the pipe free from foreign materials and in a clean and sanitary condition until its acceptance by the District Engineer.

3.05 PIPE LAYOUT FOR STRAIGHT AND CURVED ALIGNMENTS

A. Use integral bell end pipe for straight alignments and for radii greater than 1,150 feet.

B. Use the following various combinations of plain end pipe lengths with high deflection couplings and integral bell end pipe for curved alignments in both horizontal and vertical directions. Do not bend pipe between couplings. Saw cut integral bell end of standard pipe and bevel end for use with deflection couplings. Use 9.5-foot plain end pipe lengths with deflection couplings for all radii between 140 feet to 270 feet. Use 19-foot plain end pipe lengths with deflection couplings for all radii between 270 feet to 560 feet. Use an integral bell end pipe length joined together with a 19-foot plain end pipe length to form a chord. Use deflection couplings on each end of the chord and continue this combination through the curved alignment for all radii between 560 feet to 1,150 feet. Pipe lengths shorter than 9 feet will not be used unless specifically authorized by the District Engineer.

3.06 INSTALLING PIPE IN TRENCH

A. See Standard Specification Section 02223 for earthwork requirements.

B. Inspect each pipe and fitting before lowering into the trench. Clean ends of pipe thoroughly. Remove foreign matter and dirt from inside of pipe and keep clean during and after laying.

C. Handle pipe in a manner to avoid any damage to the pipe. Do not drag pipe over the ground, drop it onto the ground, or drop objects on it. Do not drop or allow pipe to fall into trenches.

D. Laying tolerances for the installed pipe shall not vary greater than 0.3-foot horizontally, or greater than 0.1-foot vertically from the alignment and elevations shown on the Drawings.

E. Grade the bottom of the trench to the line and grade to which the pipe is to be laid, with allowance for pipe thickness. Remove hard spots that would prevent a uniform thickness of pipe base material (imported sand). Before laying each section of the pipe, check the grade with a straightedge and correct any irregularities found. The trench bottom shall form a continuous and uniform bearing and support for the pipe at every point between bell holes, except that the grade may be disturbed for the removal of pipe handling slings.

F. At the location of each joint, dig bell holes in the bottom of the trench and at the sides to permit visual inspection of the entire joint and to prevent the pipe from being supported by the bell end or fitting.

G. Keep the trench in a dewatered condition during pipelaying. Removal of water shall be in conformance with Standard Specification Section 02223.

3.07 ASSEMBLING PIPE JOINTS

A. The spigot and integral bell or coupling shall be dirt free and slide together without displacing the rubber ring gasket. Lay the pipe section with the integral bell facing the direction of laying.

B. Clean the groove of the bell or coupling of all foreign materials. If the gasket groove is dirty or contains debris, carefully remove the gasket and clean the groove. Insert the gasket back into the groove of the bell or coupling prior to installation. Observe the correct direction of the shaped gasket. Feel that the gasket is completely and evenly seated in the groove.

C. Mark the full insertion depth on the spigot end of the pipe. This mark indicates when the pipe is fully inserted into toe bell or coupling. Lubricate the exposed gasket surface and the beveled spigot up to the full insertion mark with the lubricant supplied by the pipe manufacturer. For repair couplings, lubricate pipe for the entire distance the coupling will travel on the pipe. If the lubricated pipe end touches dirt, clean the pipe end and reapply lubricant.

D. Insert the spigot into the bell or coupling and force it slowly into position.

E. Check that the rubber ring gasket has not left the groove during assembly by passing a feeler gage around the completed joint.

3.08 INSTALLING BURIED FITTINGS

A. The District Engineer will inspect all fittings prior to installation for damage to the interior protective coatings. Patch damaged areas in the field with material similar to the original.

B. For mechanical joint fittings, clean the bell socket and the plain end of the pipe of all foreign material and dirt. Place the gland on the pipe spigot with the lip extension toward the plain end. Lubricate the pipe spigot and gasket. Use the same lubricant as supplied by the pipe manufacturer. Install the gasket on the pipe spigot with the narrow edge of the gasket toward the plain end. Insert the pipe into the bell socket and press the gasket firmly into the gasket recess. Keep the joint straight during assembly. Push the gland towards the socket and center it around the pipe with the gland lip against the gasket. Insert bolts and hand tighten nuts. Make joint deflection after assembly but before tightening bolts. Uniformly tighten bolts and nuts in a progressive diametrically opposite sequence, and torque nuts to 75- to 90-foot-pounds with a calibrated torque wrench.

C. For push-on joint fittings, clean the bell ends of the fitting of all foreign material and dirt. Insert the gasket in the groove of the bell and make sure the gasket faces the correct direction. Feel that the gasket is completely and evenly seated in the groove. When pipe is cut in the field, bevel the plain end prior to installation. Lubricate the exposed gasket surface and the beveled pipe spigot with the same lubricant supplied by the pipe manufacturer. Insert the spigot into the bell and force it slowly into position. Keep the joint straight while pushing. Make joint deflection after the joint is assembled.

D. When necessary to deflect pipe from a straight line in either the horizontal or vertical plane, do not exceed the following joint deflection angles for buried fittings. The angles shown are for **each joint of a ductile iron fitting** and are maximum deflection:

Nominal Pipe Size (inches)	Joint Deflection (degrees)
4	2
6	2
8	2
10	2
12	2

3.09 INSTALLING FLANGED JOINTS

A. Clean bolts, nuts and flange faces by wire brushing before installing gasket and adjoining flange. Coat bolt shafts with waterproof gear grease or primer for wax tape coating prior to insertion in flange bolt holes. Do not apply grease or primer to threads. Lubricate threads of bolts and nuts with oil or graphite prior to installation. Assemble all bolts and nuts in the flange, then uniformly tighten bolts and nuts in a progressive diametrically opposite sequence, and torque with a calibrated torque wrench. All clamping torque shall be applied to the nuts only.

B. If flanges leak under pressure testing, loosen or remove the nuts and bolts, reset or replace the gasket, reinstall or retighten the bolts and nuts, and retest the joints. Joints shall be watertight. Replace galled, cracked, or distorted bolts and nuts.

C. After testing, coat exposed surfaces of bolts and nuts to be buried with waterproof gear grease or primer for wax tape coating.

3.10 INSTALLING SERVICE SADDLES

A. Service Saddles shall be installed at a 45% angle above the spring line of the pipe. Place the service saddle on the pipe and hand tighten the nuts while positioning the saddle in its final location. Uniformly tighten the nuts in a progressive diametrically opposite sequence and torque with a calibrated torque wrench to the saddle manufacturer's recommended values.

B. Connect a corporation stop to the saddle per Standard Specification Section 15100. Apply Teflon joint compound or tape to the male threads before installing the corporation stop. Make joints watertight.

C. Mount a tapping machine on the corporation stop to cut a hole in the pipe with a shell type cutter made specifically for PVC pipe. Do not use other devices or hand equipment to bore through the pipe wall, unless approved by the District Engineer.

3.11 INSTALLING TRACER WIRE

Prior to backfill, install tracer wire on top of pipe and secure in place with 2-inch wide plastic adhesive tape at maximum 10-foot intervals. Maintain tracer wire on pipe centerline during trench backfill. Run tracer wire continuously along pipe and terminate in adjacent valve boxes for buried assemblies or buried valves. Tracer wire access ports shall be installed within the concrete splash pad of all appurtenances or in a CP Test Box. Location of all tracer wire access ports installed shall be noted on the field drawings. Where buried splices occur, use an electrical splicing kit consisting of a split bolt connector, mold, and a two part encapsulating epoxy resin such as Scotchcast, or District approved equal. Provide 24-inches of coiled wire at access points for attachment of pipe locating equipment. Each installed run of pipe shall be capable of being located using the tracer wire. Protect wire insulation from damage during installation and backfilling. Wire insulation that is broken, cut, or damaged shall be replaced.

3.12 INSTALLING WARNING/IDENTIFICATION TAPE

After the pipe zone and the first 12-inches in the trench zone have been backfilled and compacted, place the marking tape on the compacted backfill and center over the pipe. Run tape continuously along the trench and tie ends of tape together. Wrap marking tape around valve box extension pipes and continue along pipe.

3.13 SETTING MARKER POSTS

Locate marker posts 5-feet off centerline of pipeline and space at 500-feet intervals. Paint post per Standard Specification Section 09900. Use white paint for the finish coats. Stencil in 2-inch high blue letters the word "WATER" on the post. Excavate a hole 16-inches in diameter by 3-feet deep. Set the post plumb, fill hole with concrete to 2-inches above finish grade, and crown to slope away from post. Fill the post with cement grout and crown top. Paint top surface of grout when dry with blue paint. Concrete shall be per Standard Specification Section 03300.

3.14 PRESSURE TESTING

See Standard Specification Section 15044 for pressure testing requirements.

3.15 DISINFECTION

See Standard Specification Section 15041 for chlorination requirements.

END OF SECTION

SECTION 15070

PVC DISTRIBUTION PIPE (AWWA C905)

PART 1 GENERAL

1.01 DESCRIPTION

This section includes materials, installation, and testing of polyvinyl chloride (PVC) distribution pipe conforming to AWWA C905. Size range is 14-inches through 24-inches with DR 18 pipe. Maximum working pressure will be limited to 150 psi, unless directed otherwise by the District. PVC may be used in lieu of CML&C Steel only in areas of highly corrosive soils. A written request to use PVC in lieu of CML&C steel in highly corrosive soils must be submitted to the District Engineer and approved in writing.

1.02 PIPE IDENTIFICATION SYMBOLS

Interpret pipe identification symbols used on the Drawings as follows: PVC-14"-DR 18 designates type of pipe (polyvinyl chloride); nominal pipe size (14 inches); and dimension ratio (DR 18).

1.03 REFERENCE STANDARDS

AWWA C110	Ductile-Iron and Gray-Iron Fittings, 3-inch through 48-inch, For Water and Other Liquids
AWWA C111	Rubber-Gasket Joints For Ductile-Iron Pressure Pipe and Fittings
AWWA C153	Ductile-Iron Compact Fittings, 3-inch through 16-inch, For Water and Other Liquids
AWWA C905	Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14-inch through 48-inch for Water Transmission and Distribution
ASTM F477	Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM D3139	Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D1784	Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM A307	Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM D1599	Standard Test Method for Resistance to Short-Time Hydraulic Failure Pressure of Plastic Pipe, Tubing, and Fittings
ASTM D2241	Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D2252	Standard Specification for Fineness of Types of Alpaca
ASTM D1248	Standard Specification for Polyethylene Plastics Extrusion Materials For Wire and Cable

1.04 RELATED WORK SPECIFIED ELSEWHERE

FPUD	Standard Drawings
Section 02223	Trenching, Backfilling, and Compacting
Section 03300	General Concrete Construction
Section 09900	Painting and Coating
Section 13110	Corrosion Control for Buried Piping
Section 15041	Disinfection of Piping
Section 15044	Pressure Testing of Piping
Section 15056	Ductile-Iron Pipe and Fittings

1.05 SUBMITTALS

A. Submit shop drawings in accordance with Section 1 General Conditions.

B. Provide affidavit of compliance with AWWA C905.

C. Submit copies of the following required tests conducted on the project pipe by the manufacturer:

1. Quick-burst strength of pipe.
2. Flattening resistance of pipe.
3. Impact resistance of pipe.
4. Acetone-immersion test of pipe material.
5. Internal pressure and vacuum tests of joints per ASTM D 3139.
6. Laboratory tests of gaskets per ASTM F 477.
7. Record of additional tests after test sample failure.

D. Submit manufacturer's literature on ductile iron fittings conforming to AWWA C110 including dimensions, thickness, weight, coating, lining, and a statement of inspection and compliance with the acceptance tests of AWWA C110.

E. Submit manufacturer's literature on ductile iron fittings conforming to AWWA C153 including dimensions, thickness, weight, coating, and lining. Submit certificate of compliance with AWWA C153. Include legible engineering analysis sealed by a registered professional engineer or test results confirming the hydrostatic design in accordance with Section 53-5.3 of AWWA C153 for each size and configuration of fitting to be supplied. Submit results of foundry tests required by AWWA C153 including chemical analysis per Section 53-13.

F. Submit dimensions of push-on joints and other joints which do not conform to rubber-gasket joints in accordance with AWWA C111.

G. Submit manufacture's catalog data and descriptive literature for tracer wire and marking tape.

1.06 INSPECTION AND FIELD VERIFICATION

A. The District Engineer shall inspect materials, productions, and testing at manufacturer's plant.

B. Where new pipelines are to be connected to existing waterlines of the District, the Contractor shall verify in the field the location, elevation, pipe material, pipe outside diameter, and any other characteristics of the existing waterline before proceeding with the pipe installation. This field verification shall be performed in the presence of the District Engineer.

PART 2 MATERIALS

2.01 PVC PIPE

Pipe shall be polyvinyl chloride (PVC) conforming to AWWA C905 with material cell classification 12454-B per ASTM D 1784. Provide standard pipe having integral bell and spigot with elastomeric gasket and cast iron equivalent outside diameter. Provide pipe in standard 20-foot laying lengths. Straight pipe sections with plain ends for use with high deflection couplings are not available. Random lengths will not be permitted. Provide pipe with cast iron equivalent outside diameter and a dimension ratio (DR) of 18.

2.02 HIGH DEFLECTION COUPLINGS

Provide polyvinyl chloride (PVC) or ductile iron (DI) couplings with twin elastomeric gaskets which allow 2 degrees of deflection at each gasket for a total of 4 degrees per coupling. Provide couplings for cast iron equivalent outside diameter. Couplings shall be selected from the Approved Materials List.

2.03 FITTINGS

A. Provide ductile iron fittings conforming to AWWA C110 with a minimum rated working pressure of 350 psi. Provide fittings with bells and gaskets specifically designed for cast iron equivalent outside diameter PVC pipe. Use mechanical joint fittings or fittings with bells and gasket ends.

B. Compact ductile iron fittings shall conform to AWWA C153 with a minimum rated working pressure of 350 psi. Provide fittings constructed of Grade 70-50-05 ductile iron having a minimum weight equal to the weight tabulated in AWWA C153. Provide fittings with bells and gaskets specifically designed for cast iron equivalent outside diameter PVC pipe. Use mechanical joint fittings or fittings with bells and gasket ends conforming to the dimensional values of AWWA C111. Mechanical joint glands shall be Grade 70-50-05 ductile iron and cast in one continuous ring. Fittings with repaired defects are not acceptable and will be rejected.

2.04 LINING AND COATING FOR FITTINGS

Line interior of fittings per Section 15056. Provide protective coatings per section 15056 and Section 13110.

2.05 FLANGES

Flanges on ductile iron fittings shall conform to AWWA C110 or ANSI B16.42 Class 150. Refer to Section 15056.

2.06 BOLTS, NUTS AND GASKETS FOR FLANGES

A. Provide stainless steel Type 316L bolts and nuts for buried flanges and 307 grade b cad plated carbon steel for above ground, unless otherwise specified on the plans or approved by the District Engineer.

B. Provide washers for each nut. Washers shall be of the same material as the nuts.

C. Gaskets shall be asbestos-free, drop-in ring type, 1/16-inch or 1/8-inch thick, and shall be acrylic or aramid fiber bound with nitrile. Provide Garlock "Bluegard," Klinger "Klingersil C4400," or District approved equal. Gaskets shall be suitable for a water pressure of 500 psi at a temperature of 400ºF.

2.07 OUTLETS

A. For outlets 2-inches and smaller with working pressure 150 psi or less, attach a service saddle and corporation stop to the pipe. Provide service saddles constructed completely of Type 304 stainless steel. Saddles shall be a two piece, full circumference shell band bolted together with six bolts. Saddles shall have O-ring gaskets and outlets for iron pipe threads. All stainless steel shall be fully passivated for enhanced corrosion resistance. All saddles shall be sized for installation on cast iron equivalent outside diameter PVC pipe conforming to AWWA C905. Service saddles shall be Romac Industries Style 305, or District approved equal.

B. For outlets 3-inches and larger, use a ductile iron tee with a flanged outlet.

2.08 FLEXIBLE PIPE COUPLINGS

Flexible pipe couplings shall be selected from the Approval Materials List.

2.09 FLANGE COUPLING ADAPTERS

Flange coupling adapters shall be selected from the Approved Materials List.

2.10 TRACER WIRE - METALLIC

Use AWG No.8 stranded copper wire with high molecular weight polyethylene (HMW/PE) insulation specifically designed for direct burial in corrosive soil or water. Polyethylene insulation shall conform to ASTM D 1248, Type 3, Class C, Grade 5. Wires with cut or damaged insulation are not acceptable and replacement of the entire wire which has been damaged will be required at the Contractor's expense. Tracer wire shall be tested and verified by the District Engineer.

2.11 WARNING/IDENTIFICATION TAPE

Use marking tape as defined in specification section 15000, 2.08. Identification Tape shall be selected from the Approved Materials List.

2.12 MARKER POSTS

When pipeline is located outside of paved street, provide marker posts for buried pipelines at 500 feet on center or as directed by the District Engineer. Use 6-inch diameter schedule 40 steel pipe, filled with cement grout and painted white with blue stenciled lettering indicating “WATER.”. See FPUD Standard Detail W-13 for Guard Posts.

PART 3 EXECUTION

3.01 PRODUCT MARKING

Legibly mark pipe at 5-foot intervals to identify the nominal pipe size, OD base, PVC, dimension ratio number and pressure class, AWWA C905, manufacturer's name and production code, and the seal of the testing agency that verified the suitability of the material for potable water service.

3.02 DELIVERY AND TEMPORARY STORAGE OF PIPE

A. Ship, store, and place pipe at the storage yard or installation site by supporting the pipe uniformly. Avoid scratching the pipe surface. Do not stack higher than 4 feet nor stack with weight on bells. Cover to protect from sunlight.

B. Do not install pipe that is gouged or scratched forming a clear depression.

C. Do not install pipe contaminated with a petroleum product (inside or outside).

D. Do not install any pipe that shows evidence of exposure to sunlight, age, surface deterioration, or other physical damage. The decision of the District Engineer shall be final as to the acceptability of the pipe to be installed.

3.03 HANDLING OF PIPE

Lift pipes with mechanical equipment using wide belt slings. Do not use cable slings or chains.

3.04 PREVENTING FOREIGN MATTER FROM ENTERING THE PIPE

At all times when pipe laying is not in progress, the open end of the pipe shall be closed with a tight-fitting cap or plug to prevent the entrance of foreign matter into the pipe. These provisions shall apply during the noon hour as well as overnight. In no event shall the pipeline be used as a drain for removing water which has infiltrated into the trench. The Contractor shall maintain the inside of the pipe free from foreign materials and in a clean and sanitary condition until its acceptance by the District.

3.05 PIPE LAYOUT FOR STRAIGHT AND CURVED ALIGNMENTS

A. Use integral bell end pipe for straight alignments and for radii greater than 1,150 feet.

B. Use the following various combinations of plain end pipe lengths with high deflection couplings and integral bell end pipe for curved alignments in both horizontal and vertical directions. Do not bend pipe between couplings. Saw cut integral bell end of standard pipe and bevel end for use with deflection couplings. Use 9.5-foot plain end pipe lengths with deflection couplings for all radii between 140 feet to 270 feet. Use 19-foot plain end pipe lengths with deflection couplings for all radii between 270 feet to 560 feet. Use an integral bell end pipe length joined together with a 19-foot plain end pipe length to form a chord. Use deflection couplings on each end of the chord and continue this combination through the curved alignment for all radii between 560 feet to 1,150 feet. Pipe lengths shorter than 9 feet shall not be used unless specifically authorized by the District Engineer.

3.06 INSTALLING PIPE IN TRENCH

A. See Standard Specification Section 02223 for earthwork requirements.

B. Inspect each pipe and fitting before lowering into the trench. Clean ends of pipe thoroughly. Remove foreign matter and dirt from inside of pipe and keep clean during and after laying.

C. Handle pipe in a manner to avoid any damage to the pipe. Do not drag pipe over the ground, drop it onto the ground, or drop objects on it. Do not drop or allow pipe to fall into trenches.

D. Laying tolerances for the installed pipe shall not vary greater than 0.3-foot horizontally, or greater than 0.1-foot vertically from the alignment and elevations shown on the Drawings.

E. Grade the bottom of the trench to the line and grade to which the pipe is to be laid, with allowance for pipe thickness. Remove hard spots that would prevent a uniform thickness of pipe base material (imported sand). Before laying each section of the pipe, check the grade with a straightedge and correct any irregularities found. The trench bottom shall form a continuous and uniform bearing and support for the pipe at every point between bell holes, except that the grade may be disturbed for the removal of pipe handling slings.

F. At the location of each joint, dig bell holes in the bottom of the trench and at the sides to permit visual inspection of the entire joint and to prevent the pipe from being supported by the bell end or fitting.

G. Keep the trench in a dewatered condition during pipelaying. Removal of water shall be in conformance with Standard Specification Section 02223.

3.07 ASSEMBLING PIPE JOINTS

A. The spigot and integral bell shall be dirt free and slide together without displacing the rubber ring gasket. Lay the pipe section with the integral bell facing the direction of laying.

B. Clean the groove of the bell of all foreign materials. If the gasket groove is dirty or contains debris, carefully remove the gasket and clean the groove. Insert the gasket back into the groove of the bell prior to installation. Observe the correct direction of the shaped gasket. Feel that the gasket is completely and evenly seated in the groove.

C. Mark the full insertion depth on the spigot end of the pipe. This mark indicates when the pipe is fully inserted into the bell. Lubricate the exposed gasket surface and the beveled spigot up to the full insertion mark with the lubricant supplied by the pipe manufacturer. If the lubricated pipe end touches dirt, clean the pipe end and reapply lubricant.

D. Insert the spigot into the bell and force it slowly into position.

E. Check that the rubber ring gasket has not left the groove during assembly by passing a feeler gauge around the completed joint.

3.08 INSTALLING BURIED FITTINGS

A. The District Engineer will inspect all fittings prior to installation for damage to the interior protective coatings. Patch damaged areas in the field with material similar to the original.

B. For mechanical joint fittings, clean the bell socket and the plain end of the pipe of all foreign material and dirt. Place the gland on the pipe spigot with the lip extension toward the plain end. Lubricate the pipe spigot and gasket. Use the same lubricant as supplied by the pipe manufacturer. Install the gasket on the pipe spigot with the narrow edge of the gasket toward the plain end. Insert the pipe into the bell socket and press the gasket firmly into the gasket recess. Keep the joint straight during assembly. Push the gland towards the socket and center it around the pipe with the gland lip against the gasket. Insert bolts and hand tighten nuts. Make joint deflection after assembly but before tightening bolts. Uniformly tighten bolts and nuts in a progressive diametrically opposite sequence, and torque nuts to 75 to 90-foot-pound with a calibrated torque wrench.

C. For push-on joint fittings, clean the bell ends of the fitting of all foreign material and dirt. Insert the gasket in the groove of the bell and make sure the gasket faces the correct direction. Feel that the gasket is completely and evenly seated in the groove. When pipe is cut in the field, bevel the plain end prior to installation. Lubricate the exposed gasket surface and the beveled pipe spigot with the same lubricant supplied by the pipe manufacturer. Insert the spigot into the bell and force it slowly into position. Keep the joint straight while pushing. Make joint deflection after the joint is assembled.

3.09 INSTALLING FLANGED JOINTS

A. Clean bolts, nuts and flange faces by wire brushing before installing gasket and adjoining flange. Coat bolt shafts with waterproof gear grease or primer for wax tape coating prior to insertion in flange bolt holes. Do not apply grease or primer to threads. Lubricate threads of bolts and nuts with oil or graphite prior to installation. Assemble all bolts and nuts in the flange, then uniformly tighten bolts and nuts in a progressive diametrically opposite sequence, and torque with a calibrated torque wrench. All clamping torque shall be applied to the nuts only.

B. If flanges leak under pressure testing, loosen or remove the nuts and bolts, reset or replace the gasket, reinstall or retighten the bolts and nuts, and retest the Joints. Joints shall be watertight. Replace galled, cracked, or distorted bolts and nuts.

3.10 INSTALLING SERVICE SADDLES

A. Place the service saddle on the pipe and hand tighten the nuts while positioning the saddle in its final location. Uniformly tighten the nuts in a progressive diametrically opposite sequence and torque with a calibrated torque wrench to the saddle manufacturer's recommended values.

B. Mount a tapping machine on the corporation stop to cut a hole in the pipe with a shell type cutter made specifically for PVC pipe. Do not use other devices or hand equipment to bore through the pipe wall.

3.11 INSTALLING WAX TAPE

Wrap buried service saddles, fittings and flanged joints with wax tape pre section 13110. Complete the wrap prior to placing concrete anchors, supports, or thrust blocks per Standard Specification Section 02223. Repair polyethylene material damaged during construction.

3.12 INSTALLING TRACER WIRE

Prior to backfill, install tracer wire on top of pipe and secure in place with 2-inch wide plastic adhesive tape at maximum 10-foot intervals. Run tracer wire continuously along pipe and terminate in adjacent valve boxes for buried assemblies or buried valves. Where buried splices occur, use an electrical splicing kit consisting of a split bolt connector, mold, and two part encapsulating epoxy resin such as Scotchcast, or District approved equal. Provide 24-inches of coiled wire at access points for attachment of pipe locating equipment. Each installed run of pipe shall be capable of being located using the tracer wire. Protect wire insulation from damage during installation and backfilling. Wire insulation that is broken, cut, or damaged shall be replaced.

3.13 INSTALLING WARNING/IDENTIFICATION TAPE

After the pipe zone and the first 12-inches in the trench zone have been backfilled and compacted, place the marking tape on the compacted backfill and center over the pipe. Run tape continuously along the trench and tie ends of tape together. Wrap marking tape around valve box extension pipes and continue along pipe.

3.14 SETTING MARKER POSTS

Locate marker posts 5-feet off centerline of pipeline and space at 500-feet intervals. Paint post per Standard Specification Section 09900. Use white paint for the finish coats. Stencil in 2-inch high blue letters the word "WATER" on the post. Excavate a hole 16-inches in diameter by 3 feet deep. Set the post plumb, fill hole with concrete to 2-inches above finish grade, and crown to slope away from post. Fill the post with cement grout and crown top. Paint top surface of grout when dry with blue paint. Concrete shall be per Standard Specification Section 03300.

3.15 PRESSURE TESTING

See Standard Specification Section 15044 for pressure testing requirements.

3.16 DISINFECTION

See Standard Specification Section 15041 for chlorination requirements.

END OF SECTION

SECTION 15076

CEMENT-MORTAR LINED AND COATED (CML&C) STEEL PIPE

PART 1 GENERAL

1.01 DESCRIPTION

This section designates the requirements for steel pipe fabrication, test in shop, installation of steel pipe, fabrication of steel sheet or plate, mill-manufactured steel pipe, bends, special pipes with outlets, pass holes, flanges and all other fittings. Steel pipe shall conform to the following except as modified by this Specification:

1.02 REFERENCE STANDARDS

The publications listed below form part of this specification to the extent referenced and are referred to in the text by the basic designation only. Reference shall be made to the latest edition of said standards unless otherwise called for:

AWWA C200	Steel Water Pipe 6-inches and larger
AWWA C205	Cement-mortar protective lining and coating
AWWA C207	Steel Pipe Flanges
AWWA C210	Coal-tar epoxy coating system for interior and exterior of steel water pipelines
AWWA C213	Fusion-Bonded epoxy coating for the interior and exterior of steel water pipelines
AWS	Standard Qualification Procedure for Manual Welding Operators
ASME	Boiler and Pressure Vessel Code

1.03 RELATED WORK DESCRIBED ELSEWHERE

The publications listed below form part of this specification to the extent referenced and are referred to in the text by the basic designation only. Reference shall be made to the latest edition of said standards unless otherwise called for.

Section 09900	Painting and Coating
Section 15041	Disinfection of Piping

1.04 SUBMITTALS

The Contractor shall furnish submittals in accordance with Section 1 General Conditions. Submittals are required for the following:

A. Submit Shop Drawings, material lists, manufacturer's literature and catalog cuts of, but not limited to, the following:

Shop Drawings	Fabrication Details
Layout Schedule	Dimensional Checks
Manufacturer's tests	Protective Coatings
Mill Reports or Plant Test Reports	Welding Rods for Field Welding

B. Shop Drawings shall be submitted and approved prior to manufacture of pipe. The layout schedule shall indicate the order of installation, the length and location of each pipe section and special, the station and elevation of the pipe invert at all changes in grade, and all data on curves and bends for both horizontal and vertical alignment.

C. Submit data used by the Contractor in manufacture and quality control.

D. Test reports showing the physical properties of the rubber used in the gaskets shall be submitted.

PART 2 MATERIALS

2.01 PIPING

A. Steel pipe shall conform to AWWA C200. The steel for the cylinder shall be designed for a minimum of 300 psi working pressure and 36,000 psi minimum yield strength conforming to requirements for ASTM A36. Steel cylinder shall be 3/16" thick minimum. Pipe shall be thicker where required for restrained couplings.

B. Fittings for steel pipe shall conform to the dimensions of AWWA C208 and shall be made of segmentally welded sections of hydrostatically tested pipe (same material and thickness), with ends compatible for type of joints shown. The minimum radius of elbows shall be 2.5 times the pipe diameter and the maximum miter angle on each section of elbow shall not exceed 11.25 degrees. Fittings shall be equal in pressure design strength and shall have the same lining and coating as the abutting pipe.

C. Steel pipe joints shall be welded, unless otherwise indicated. Closure pieces shall be butt straps. The straps shall be furnished in one or two sections, requiring one or two longitudinal welds in addition to the circumferential fillet welds. Provide steel flanges, welded to pipe where indicated. Flanges shall be in accordance with AWWA C207 Class D. Linings or coatings shall be continuous to the end of the pipe or back of the flange. Flange faces shall be shop cloth-inserted rubber. Bolts on buried flanges shall be Type 316 stainless steel with coal tar epoxy applied after installation.

D. Cement mortar lining for steel pipes shall conform to the following:

1. Except as otherwise provided in AWWA C205, the interior of all steel pipe, fittings and specials, shall be cleaned and lined in the shop with cement mortar lining applied centrifugally in conformance with AWWA C205. Every precaution shall be taken to prevent damage to the lining. If lining is damaged or found faulty at the construction site, the damage or unsatisfactory portions shall be replaced with lining conforming to these specifications.

2. The pipe ends shall be left bare where field joints occur. Ends of the lining shall be left square and uniform. Feathered or uneven edges will not be permitted.

3. Defective linings as identified in AWWA C205 shall be removed from the pipe wall and shall be replaced to the full thickness required. Defective linings shall be cut back to a square shoulder in order to avoid feather-edged joints.

4. 5-inch minimum hand holes shall be required, unless directed otherwise by the District Engineer, to facilitate interior lining repairs at all joints.

E. Cement mortar coating for steel pipes shall conform to the following:

1. All buried pipe shall receive a ¾-inch thick reinforced cement mortar coating. The coating shall be reinforced with spirally wound No. 14 gauge steel wire spaced at 1-½ inch centers positioned approximately at the center of the mortar coating. In lieu of a spirally wound wire, a wire mesh or wire fabric may be used. The mesh or fabric shall be fastened with welded wire clips or strips of metal so as to hold the wire approximately at the center of the mortar coating. Splices shall be lapped four inches and the free ends tied or looped to ensure continuity.

2. After the welding is completed, the outside annular spaces between pipe sections shall be completely filled with grout. The grout shall be poured in such a manner that all exposed portions of the metal joint shall be completely protected with cement mortar. Grout used on the outside of joints shall be non-shrink grout, sufficiently fluid to permit it to be poured down one side of the pipe and allowed to flow up the other side. The outside mortar joints shall be properly formed by the use of heavy-duty diapers or grout bands.

2.02 STEEL BAR OR WIRE REINFORCEMENT

Circumferential steel bar or wire reinforcement shall conform to ASTM A615, Grade 60, "Specifications for Billet-Steel Bars for Concrete Reinforcement". Wire fabric reinforcing for cement-mortar coatings and linings of fittings shall conform to ASTM A185, "Specifications for Welded Steel Wire Fabric," or ASTM A497, "Specifications for Welded Deformed Steel Wire Fabric." Spiral-wire reinforcement for cement-mortar coatings shall conform to ASTM A82.

2.03 STEEL FOR JOINT RINGS

Steel for bell rings shall conform to ASTM A575, "Specification for Merchant Quality Hot Rolled Carbon Steel Bars." Steel for spigot rings shall conform to ASTM A576, "Specification for Special Quality Hot-Rolled Carbon Steel Bars."

2.04 MANUFACTURER'S TESTS

A. Each steel cylinder with joint rings attached and cylinders for specials shall be hydrostatically tested to a circumferential stress of at least 22,000 psi, but not more than 25,000 psi. If leaks develop during testing, the cylinder shall be repaired by welding and retested until all leaks are eliminated.

B. The seams in short radius bends and special fittings shall be tested by the air-soap method using air at a pressure of 5 psi or by the dye-check method. However, if the fitting is

fabricated from cylinders which have been previously hydrostatically tested, no further test will be required on seams so tested.

C. Hydrostatic testing of fittings to 150% of the design pressure may replace the tests described above. Any defects revealed by any of the alternate test methods shall be repaired by welding and the fitting retested until all defects have been eliminated.

2.05 FABRICATION DETAILS

A. Each special and each length of straight pipe shall be plainly marked at the bell end to identify the design pressure and the proper location of the pipe or special by reference to layout schedule.

B. Exposed portion of joint rings shall be protected from corrosion by the manufacturer's standard coating.

2.06 HANDLING AND SHIPMENT

Pipe and special fittings shall be handled carefully, and blocking and holddowns used during shipment shall prevent movement or shifting. Both ends of pipe and fittings on trucks or rail cars shall be bulkheaded or covered in order to prevent excessive drying of the interior lining.

PART 3 EXECUTION

3.01 INSTALLATION

A. Trench Preparation: Earthwork shall be carried out in accordance with Section 02200, Earthwork. Pipe laying shall be scheduled so that the bell end of the pipe faces in the direction of laying. Pipe installation on slopes steeper than 20% shall be laid in an uphill direction. Prior to laying the pipe, the bottom of the trench shall be graded and prepared to provide uniform bearing throughout the entire length of each joint of pipe. Suitable bell holes shall be excavated at each joint and a shallow lateral depression shall be scooped out half a pipe length from the last pipe laid to allow for easy removal of the belt pipe sling and thus avoid any movement of the pipe after it is placed on proper line and grade.

B. Butt-Strap Closure Joints: Butt-strap closure joints shall be completed in the trench after the pipe has been laid to the alignment and grade shown on the Plans. They shall be field welded by full-circumferential fillet welds or one of the edges may be shop welded and the other field welded. Welding shall be done in the same manner as specified for welded joints.

1. The interior of the joints shall be filled with stiff plastic mortar and finished off smoothly with the inside of the pipe.

2. Wire mesh, 2-inch by 4-inch by No. 13 gauge, clean, and free from rust, shall be applied to the exterior of the joints so that the wires on the 2-inch spacing run circumferentially around the pipe. The wires on the 4-inch spacing shall be crimped in such a manner that the mesh will be held 3/8-inch from the metal joint surface. The mesh shall be lapped a minimum of 8-inches and shall be securely wired in position.

3. The joint exterior shall be coated with mortar to a minimum thickness of 1½-inches. Immediately prior to applying mortar to the interior or exterior of the joints, a cement wash shall be applied to the metal to be coated

C. Welded Joints: Welded joints shall be completed after the pipe is in final position. Welded joints shall be a lap-welded slip joint as shown on the Plans. Any recess between the bell and spigot shall be caulked with a rod to facilitate the welding. Pipe of 30-inches in diameter or more may be welded from the inside. Welders assigned to the Work shall be qualified under the AWS standard qualification procedure.

1. Joints to be welded shall be cleaned, preferably prior to placing the pipe in the trench, of all loose scale, heavy rust, paint, cement, and grease. At least a 1/2-inch recess shall be provided between adjacent mortar-covered surfaces to place the weld. In all hand welding, the metal shall be deposited in successive layers and the minimum number of passes or beads in the completed weld shall be as follows:

Steel Cylinder Thickness (Inches)	Fillet Weld Minimum Number of Passes
Smaller than 3/16	1
3/16 and 1/4	2
5/16	3
3/8	3

2. After the joints have been welded, the joint shall be grouted with cement mortar in the same manner as specified for rubber-ring joints.

3.02 PREVENTING FOREIGN MATTER FROM ENTERING THE PIPE

At all times when pipe laying is not in progress, the open end of the pipe shall be closed with a tight-fitting cap or plug to prevent the entrance of foreign matter into the pipe. These provisions shall apply during the noon hour as well as overnight. In no event shall the pipeline be used as a drain for removing water which has infiltrated into the trench. The Contractor shall maintain the inside of the pipe free from foreign materials and in a clean and sanitary condition until its acceptance by the District Engineer.

3.03 PRESSURE TEST

All pipelines shall be tested in accordance with Section 15044, Hydrostatic Testing of Piping. Zero leakage is allowed and all visible leaks must be repaired regardless of the results of the leakage allowance measurements.

3.04 DISINFECTION

Disinfection shall be in accordance with Section 15041, Disinfection of Piping.

END OF SECTION

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SECTION 15100

VALVES

PART 1 GENERAL

1.01 DESCRIPTION

This section includes materials, testing, and installation of manually operated valves, check valves, air and vacuum valves, air-release valves, and combination air-release valves.

1.02 REFERENCE STANDARDS

ASTM A307	Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A193	Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A194	Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both
ASTM A126	Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A48	Standard Specification for Gray Iron Castings
ASTM A276	Specification for Hot- and Cold-Finished Bars of Stainless and Heat-Resisting Chromium-Nickel-Manganese Steel
ASTM B62	Standard Specification for Composition Bronze or Ounce Metal Castings
AWWA C105	Polyethylene Encasement For Ductile Iron Piping For Water And Other Liquids
AWWA C500	Gate Valves For Water And Sewerage Systems
AWWA C504	Rubber Seated Butterfly Valves
AWWA C509	Resilient Seated Gate Valves For Water And Sewerage Systems

1.03 RELATED WORK SPECIFIED ELSEWHERE

FPUD	Standard Drawings
Section 09900	Painting and Coating
Section 15041	Disinfection of Piping

1.04 SUBMITTALS

Contractor shall furnish submittals in accordance with the requirements of Section 1 General Conditions. The following submittals are required:

A. Submit Shop Drawings, manufacturer's catalog data and detail construction sheets showing all valve parts and describing material of construction by material and specification (such as AISI, ASTM, SAE, or CDA). Submittal shall include valve dimensions including laying lengths, dimensions and orientation of valve operators, as installed on the valves. Submittals shall also indicate valve linings and coatings with manufacturer's and paint numbers listed.

B. For valves requiring certified tests, submit certified test results. Provide number of turns for valves 14 inches and larger. All valves 20 inches and larger shall be shop tested at specified pressure for leaks.

1.05 MASONRY RETAINING WALLS

If the aboveground portion of the assembly is located within a cut slope or embankment fill, a masonry retaining wall shall be constructed on three sides around the assembly per drawing W-16. The face of wall shall be a minimum of one foot beyond the dimensional values of the concrete pad to be poured for the assembly as shown on the Standard Drawings. Use tan colored slump block and grout each cell solid. The concrete pad to be poured around the assembly shall extend to the face of the three walls and also to the adjacent sidewalk or curb. The District Engineer will decide whether the requirements of this paragraph are being followed by the Contractor. If in the opinion of the District Engineer modifications or changes are necessary, the work shall be performed as directed.

PART 2 MATERIALS

2.01 GENERAL

All valves shall be new and of current manufacture. Valves shall be furnished and installed by the Contractor at the location and in accordance with the type of ends as shown on the Plans and as herein specified.

The manufacturer shall have manufactured tight-closing valves of the valve type intended for use for a period of at least five (5) years.

The Contractor shall furnish and install each specific type of valve from a single manufacturer and use it throughout the Work.

All valves shall have a rated working pressure of at least 150 psi. All valves shall be certified to meet the test pressure as specified and shall have a rated working pressure that exceeds the full working pressure specified.

A. Connections: Valves shall have flanged, hub, screwed, or special connector ends as shown on the Plans. Where not indicated, the valves shall have the same type of connection as the pipeline in which valves are to be installed and conform to the Specifications.

B. Bolts, Nuts and Washers: Bolts, nuts and washers for above ground installations shall be cadmium plated and shall conform to ASTM A307, Grade B, "Steel Machine Bolts and Nuts and Tap Holes," when a ring gasket is used and shall conform to ASTM A193, "Alloy-Steel Bolting Material for High Temperature Service", when a full-face gasket is used. Bolts and nuts shall be heavy hexagon series. Nuts shall conform to ASTM A194, "Carbon and Alloy Steel Nuts for Bolts for High Pressure and High Temperature Service" either in Grade 1, 2, or 2H. The fit shall be ANSI B1.1, "Unified Screw Threads," Class 2, except that Class 3 fit shall be used in holes tapped for studs. Threads may be made by either cutting or cold forming. Between 1/4-inch and 3/8-inch shall project through the nut when drawn tight.

    1. Bolts, nuts and washers for underground installations including below ground structures shall be type 316 stainless steel. All buried bolts shall be completely coated with Bitumastic No. 50, or approved equal, which must be applied in two coats to a minimum thickness of 15 mils per coat.

    2. All aboveground bolt threads shall be lubricated with graphite and oil. Flanged faces shall be wire brushed and cleaned prior to joining each flange.

C. Polyethylene Encasement: Unless otherwise specified on the Plans, all valves for underground installation shall be encased in two layers of 8 mil polyethylene wrap in accordance with AWWA C105.

D. Painting and Coating: All valves referenced in this section shall be painted and coated, interior and exterior, in accordance with Part 2.09, Painting and Coating.

2.02 PLUG VALVES - LUBRICATED

A. The valves shall be lubricated, tapered plug valves. The valves shall be a top entry, bolted gland design.

B. Unless otherwise specified, valves shall have cast iron bodies and tapered plugs with bolted ductile iron, malleable iron, or steel covers depending on pressure rating of the valves. Valve castings shall be of the very highest quality obtainable. Valve stem shall be stainless steel. The segment gear shall have the valve stops welded prior to installation as directed by District Engineer. Weld repair of cast iron castings is not permissible. All body bolts shall be 316 Stainless Steel.

C. A ground valve plug shall be lapped to the body taper during the manufacturing process to establish an ultimate fit between these two items.

D. The valves shall be supplied with a sealant system which allows application of a sealing media to the metallic valve seats as a means of establishing drip-tight sealing. The valve shall be furnished with a single point of application sealant system, and shall incorporate a double ball check valve between the sealant application point and the sealant system to eliminate the potential for leakage of line media to atmosphere. The sealant application point of the valves shall be a combination ½-inch black iron sealant screw which allows use of injection equipment or sealant sticks. The combination sealant screw shall be of a piston check design which minimizes debris collection. Ball check sealant fittings shall not be furnished.

E. The valve shall be lubricated with a FDA and NSF approved lubricant suitable for potable water during installation. The lubricant shall be per the valve manufacturer's recommendation.

F. A flexible, stainless steel diaphragm shall be provided under the valve cover, and shall bear against the top of the plug to provide a primary stem seal mechanism. The valve cover shall be sealed to the body by non-asbestos containing gaskets loaded in place by capscrews.

G. A gland assembly shall be provided which shall control plug adjustment without working through compressible packing and shall not allow adjustment to be lost due to packing compression over time. Gland assembly shall have nitrile elastomer O-ring seals which bear against the plug shank and the valve cover as a provision for a secondary stem seal mechanism.

H. Enclosed worm gear operators shall be furnished. Wrench operated valves shall be available when specified on certain smaller sized valves. Gear operators shall be an integral part of the valve design and shall provide for basic isolation of the valve adjustment gland, valve stops, etc., from the general environment. When specified, gearing shall be furnished as a tightly sealed waterproof design capable of withstanding 15-feet head of water, and such design shall also serve to totally protect the gland, and gland adjusting mechanism from the environment. Gearing shall consist of a ductile iron segment keyed to the valve stem.

I. The segment shall be driven by a hardened steel worm gear. Both the segment and the worm gear shall be dry film lubricated with molybdenum disulfide. The worm gear shall be attached to

an input shaft which is supported by thrust bearings. The gearing shall be lubricated by high quality extreme pressure gear grease.

J. Valve shall conform to Valve Manufacturer's Standardization Society Specification MSS SP-78; CAST IRON PLUG VALVES, FLANGED AND THREADED ENDS. The valve shall conform to the following standards, where applicable; ANSI B16.1, ANSI B1.20.1, ASTM-A 126, class B, MSS SP-6, MSS SP-25, and AWWA C110/A21.10-87. Face to face dimensions shall conform to ANSI B16.10.

K. The valve manufacturer shall offer a five (5) year warranty against defects in materials and workmanship.

L. The valves shall be a Venturi pattern design, and range in size from 8" - 24". The valves shall be rated for a minimum working pressure of 400 psi Cold Working Pressure (CWP) for sizes 6" - 12", and 300 psi CWP for sizes 14" - 24". The valves shall be hydrostatically shell pressure tested at twice the CWP rating. Each valve seat shall be tested at 150% CWP pressure in lieu of the SP-78 specified 110% CWP. The valve shall have flanged ends drilled to ANSI Class 250 Cast Iron Flange Templates. Valves 20 inch and larger shall be shop tested at 200 psig for leaks.

M. Lubricated plug valves shall be selected from the Approved Materials List.

2.03 BUTTERFLY VALVES

A. All butterfly valves shall be of the tight-closing, rubber-seat type, with rubber seats which are recess mounted and securely fastened to the valve body and in full compliance with AWWA C504. Valves shall be bubble tight at rated pressures and shall be satisfactory for applications involving valve operation after long periods of inactivity. Valve discs shall rotate 90 degrees from the full open position to the tight shut position. Valves shall meet the full requirements of the applicable classes of AWWA C504.

B. Valve bodies shall be constructed of cast-iron ASTM A126, Class B unless otherwise specified on the Plans. Flange drilling shall be in accordance with ANSI B 16.1 standard for cast-iron flanges. Two trunnions for shaft bearings shall be integral with each valve body. Body thickness shall be strictly in accordance with AWWA C504.

C. All valve discs shall be constructed of high-strength cast iron in accordance with ASTM A48, Class 40. All disc seating edges shall be smooth and polished.

D. Shafts of all valves shall be turned, ground, and polished. Valve shafts shall be constructed of 18-8, Type 304 stainless steel.

E. Valve seats shall be of a continuous natural rubber or a synthetic rubber compound mounted on the body and a stainless steel seat mounted on the disc. Bonded-in seats must be simultaneously molded-in, vulcanized, and bonded to the body and the seat bond must withstand 75-pound pull under test pressure in accordance with ASTM A276. Valve seats on valves 24-inches and larger shall be field adjustable and replaceable without dismantling operator, disc, or shaft and without removing the valve from the line. Valves employing a complete rubber liner will not be acceptable in any size.

F. Each valve shall be provided with one or more thrust bearings in accordance with AWWA C504. Thrust bearings which utilize a ferrous metal bearing surface in direct rubbing contact with an opposing ferrous metal surface will not be acceptable.

G. Valves shall be fitted with sleeve-type bearings. Bearings shall be corrosion resistant and self-lubricating. Bearing load shall not exceed 2,500 psi.

H. The use of a stop or lug cast integrally with or mechanically secured to the body for the purpose of limiting disc travel by means of direct contact or interference with the valve disc in either the open or closed position will not be acceptable.

I. Valve operators shall be designed to hold the valve in any intermediate position between fully opened and fully closed without creeping or fluttering.

J. For buried service operation, valve operators shall be of the enclosed gear or screwed rod type.

K. For non-buried service, valve operators shall be enclosed gear type with handwheel and valve position indicator.

L. Valve shall open with a counterclockwise rotation of the operator.

M. Valves 20 inches and larger shall be shop tested for leaks at 150 psig.

2.04 RESILIENT WEDGE GATE VALVES

A. All valves shall be new and of current manufacture. Resilient wedge valves may be used only for nominal pipe sizes from 3-inches to 24-inches in diameter, unless specified on the plans or approved by the District Engineer.

B. Valves shall be furnished and installed with the type of ends shown on the Plans and as herein specified.

C. Valves shall be manufactured to meet all applicable requirements of the latest edition of AWWA C509. Flange drilling shall be in accordance with ANSI B 16.1 standard for cast-iron flanges.

D. Valves shall have non-rising stems, opening by turning counter-clockwise. Buried valves shall be provided with 2-inch square operating nut with arrow cast in metal to indicate direction of opening, and above ground valves shall be equipped with a handwheel. Valve stems shall be integral with stem collar and furnished of 316 stainless steel. Stem nuts shall be independent of the wedge and shall be made of 316 stainless steel. All body bolts shall be ANSI type 316 stainless steel.

E. Cast-iron wedge shall have sealing surfaces of the wedge permanently bonded with resilient material to meet ASTM tests for rubber to metal bond ASTM D429. Each valve shall have a smooth unobstructed waterway free from any sediment pockets. Stuffing boxes shall be O-ring seal type with two rings located in stem above thrust collar. Low friction torque reduction thrust bearings shall be located both above and below the stem collar.

F. Valves shall have hydrostatic shell test of 400 psi and shutoff test of 200 psi. At the 200 psi shutoff test the valve must be bubble tight - zero leakage will be allowed. Conduct shutoff shop test for valves 20 inch and larger.

2.05 BALL VALVES - RUBBER SEATED

A. Ball valve shall be of the tight-closing, shaft-mounted type which fully complies with AWWA Standard C507 latest edition. Valve design shall eliminate metal-to-metal contact or wedging in the sealing action. The valve shall be designed to provide drip-tight shutoff against flow in both directions. Design of valve shall be such that, with the valve in the open position, the full and unobstructed circular inlet and outlet port diameter shall be as specified in Table 2 of AWWA Standard C507. With the valve in the closed position, valve shall be drip-tight at rated pressure.

B. The valve body shall have integral support legs or pads and shall consist of two body end pieces and a center body piece through-bolted and O-ring-sealed against leakage. All body pieces shall be of cast iron ASTM A126 Class B. Minimum body thickness shall be as specified in Table 3 of AWWA Standard C507. Unless otherwise specified, flanges shall be flat-faced, and flange drilling shall be in accordance with ANSI B16.1 standard for cast iron flanges.

C. The valve ball shall be constructed of cast iron ASTM A48, Class 40, and shall be taper-pinned to an upper and lower fitted shaft of 18-8 Type 316 stainless steel that is turned, ground and polished to a 32 micro-inch or smoother finish per ANSI B46.1. Valves employing chromium plated iron or steel shafts or trunnions are not acceptable.

D. The center section shall be fitted with sleeve-type bearings contained in the body hubs. Bearings shall be corrosion resistant and self lubricating, with minimum wall thickness of 1/4-inch. Material shall be teflon-lined with fiberglass backing. Bearing surfaces shall be isolated from flow by O-ring type seals. The ball assembly shall consist of a stainless steel stud and thrust collar in a grease-packed cavity.

E. All seats shall be of a synthetic rubber compound. Seats shall be retained in the valve body by mechanical means without retaining rings, segments, screws or hardware of any kind in the flow stream. Seats shall seal a full 360° without interruption and have a plurality of grooves mating with a spherical stainless steel seating surface on the ball. Valve seats shall be field adjustable around the full 360° circumference and replaceable without dismantling the operator, ball or shaft. Where line size permits, seats shall also be capable of being replaced or adjusted without removing the valve from the line. There shall be two (2) sets of ball and body seats to provide drip-tight closure in both directions. Manufacturer shall certify that the rubber seat is field adjustable and replaceable.

F. Ball valve shall be subjected to hydrostatic, shop leakage and performance tests as specified in Section 5.2 of AWWA Standard C507.

G. Valve actuator shall conform to the operating requirements of AWWA Standard C507 and shall be designed to hold the valve in any intermediate position between full open and full closed without creeping or fluttering. Unless otherwise specified on the Plans the valve shall be equipped with a manual actuator of the self-locking type with mechanical stop-limiting devices to prevent over travel of the ball in the open or closed position with hand wheel and position indicator for non-buried service. For buried service the valve shall be equipped with a 2-inch operating nut. Manual actuator shall be Pratt MDT or approved equal. Where cylinder actuators are specified, they shall be Pratt MDT with Dura-Cyl cylinder, or approved equal.

H. The manufacturer furnishing the valve(s) shall certify that the valve(s) meet the requirements of AWWA Standard C507.

2.06 AIR RELEASE AND VACUUM RELIEF VALVES

All assemblies shall be as shown on the Standard Drawings or as detailed on the plans. Valves and fittings shall equal or exceed the pressure rating of the pipe to which they are attached. The valve shall be a combination type and shall be sized as shown below. Air release and vacuum relief valves shall be selected from the Approved Materials List.

Pipe Size	Air Release/Vacuum Relief Size
<6”	1”
6” to 14”	2”
16” to 20”	4”
>20”	6”

A. Air and vacuum valves shall be capable of venting sufficient quantities of air as determined by the manufacturer’s approved sizing methods, while pipelines are being filled and allowing air to re-enter while pipelines are being drained.

B. Air and vacuum valves shall be of the size indicated, with flanged or screwed ends to match the piping.

C. Bodies shall be of high-strength cast iron or ductile iron. For waste water service bodies shall be 316 stainless steel.

D. The float, seat, and all moving parts shall be constructed of Type 316 stainless steel. For waste water service materials shall be reinforced nylon or polypropylene.

E. Seat washers and gaskets shall be of material insuring water tightness with a minimum of maintenance.

F. Valves shall be designed for minimum 250 psi working pressure, unless otherwise indicated.

G. Combination air/vacuum assemblies shall be installed on a section of pipe no closer than 18 inches to a bell, coupling, joint or fitting.

H. Air/vacuum assemblies and valve box assemblies shall be field coated with safety yellow paint according to Part 2.09, unless specified on the plans or approved by the District Engineer.

I. All assemblies shall be installed above ground.

J. Assemblies shall be installed with a sanitary vent screen to the exhaust port of the valve, and selected from the Approved Materials List.

K. Assemblies installed will have an isolation valve to permit future maintenance. Isolation valves installed above ground will have the capability to be locked out. Isolation valves installed below ground will be required to have a debris cap with a locking device.

2.07 CORPORATION STOPS

Corporation stops shall be manufactured of bronze conforming to ASTM B62. The inlet fitting shall be a male iron pipe thread when used with a saddle and the outlet connection shall be a compression type unless otherwise specified.

2.08 HOSE BIBBS AND VALVES

Hose bibbs shall be furnished and installed in the locations shown on the Plans and shall be of the sizes required. They shall be brass hose valves, with National Standard threads, cap, and chain.

2.09 VALVE COATING

A. Exterior Coating: Coat ferrous valves located above ground, in vaults or in structures the same as the adjacent piping. If the adjacent piping is not coated, then coat valves per this Specification section unless otherwise noted. Apply the specified prime coat at the place of manufacture. Apply intermediate and finish coats in the field. Finish coat shall match the color of the adjacent piping. Coat handwheels and floor stands the same as the valves. Coat the exterior of buried metal valves at the place of manufacture per this specification.

B. Exterior Coating (Above ground):
Shop prime coat: Tnemec Series 1 Omnithane applied at 2.5 to 3.5 mils DFT.
Touch-up (Field): Tnemec Series 1 Omnithane applied at 2.5 to 3.5 mils DFT.
Intermediate Coat: Tnemec Series V69 Epoxoline II applied at 3.0 to 5.0 mils DFT.
Finish Coat: Tnemec Series 1075 Endura-Shield II @ 2.0 to 3.0 mils DFT.

C. Exterior Coating (Buried):
Shop prime coat: Tnemec Series 1 Omnithane applied at 2.5 to 3.5 mils DFT.
Shop Intermediate Coat: Tnemec Series V69 Epoxoline II applied at 4.0 to 6.0 mils DFT.
Shop Finish Coat: Tnemec Series V69 Epoxoline II applied at 4.0 to 6.0 mils DFT.

D. Interior Lining: Valves 4-inches and larger shall be coated on their interior metal surfaces excluding seating areas and bronze and stainless-steel pieces. Sandblast surfaces in accordance with SSPC-SP-10 (near white blast cleaning). Remove all protuberances which may produce pinholes in the lining. Round all sharp edges to be coated. Remove any contaminants which may prevent bonding of the lining. Coat the interior ferrous surfaces using one of the following methods:

1. Apply powdered thermosetting epoxy per the manufacturer's application recommendations to a thickness of 10 to 12 mils.

2. Apply two (2) coats of polyamide epoxy to a dry-film thickness of 10 to 12 mils total. Follow the manufacturer's application recommendations including minimum and maximum drying time between the required coats.

3. All epoxy lining shall be applied at the factory by the manufacturer of the valve, and shall meet current Volatile Organic Compound (VOC) content regulations. Epoxy lining for potable water valves shall also be listed by National Sanitation Foundation (NSF) for contact with potable water.

4. Test the valve interior linings at the factory with a low-voltage holiday detector. The lining shall be holiday free.

PART 3 EXECUTION

3.01 INSTALLATION

A. Flanges shall be cleaned by wire brushing before installing flanged valves. Flange bolts and nuts shall be cleaned by wire brushing, and threads lubricated with NSF 61 approved product. Nuts shall be tightened uniformly and progressively. If flanges leak under pressure testing, nuts and bolts shall be loosened or removed, the gasket reseated or replaced, the bolts and nuts reinstalled or retightened, and joints retested. Joints shall be watertight.

B. Threaded joints shall be cleaned by wire brushing or swabbing. Teflon joint compound or Teflon tape shall be applied to pipe threads before installing threaded valves. Joints shall be watertight.

3.02 VALVE PRESSURE TESTING

Valves shall be tested at the same time that the connecting pipelines are pressure tested and in accordance with Section 15044, Hydrostatic Testing of Pressure Pipe. Any parts of valves, operators, or control and instrumentation systems whose pressure rating is less than the test pressure shall be isolated and protected.

END OF SECTION

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SECTION 15109

FIRE HYDRANT ASSEMBLIES

PART 1 GENERAL

1.01 DESCRIPTION

This section includes the materials for and installation of fire hydrant assemblies.

1.02 REFERENCE STANDARDS

The publications listed below form part of this specification to the extent referenced and are referred to in the text by the basic designation only. Reference shall be made to the latest edition of said standards unless otherwise called for:

AWWA C210	Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water pipelines
AWWA C213	Fusion Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines
AWWA C503	Wet-Barrel Fire Hydrants
AWWA C550	Protective Epoxy Interior Coatings for Valves and Hydrants

1.03 RELATED WORK SPECIFIED ELSEWHERE

FPUD	Standard Drawings
Section 03300	Cast-in-Place Concrete
Section 05550	Misc. Metals
Section 09900	Painting and Coating
Section 15041	Disinfection of Pipe
Section 15044	Hydrostatic Testing of Pressure Pipe
Section 15056	Ductile Iron Pipe and Fittings
Section 15076	CML&C Steel Pipe

1.04 SYSTEM DESCRIPTION

A. Hydrant outlet sizes and configuration shall be as shown on the Approved Plans or as directed by the fire department of jurisdiction.

B. Hydrants shall generally have the following number and size of outlets as directed by the fire department of jurisdiction:

1. Residential: 2 1/2-inch outlet and one (1) 4-inch outlet

2. Commercial: Two (2) 2 1/2-inch outlets and one (1) 4-inch outlet.

3. Industrial: One (1) 2 1/2-inch outlet and two (2) 4-inch outlets.

1.05 SERVICE APPLICATION

Wet-barrel hydrants shall generally be used for pressures up to 200psi. System pressures up to and including 150psi requires standard wet-barrel hydrants, and pressures up to 200psi require high-pressure wet-barrel hydrants in accordance with the Approved Materials List. Fire hydrants with higher pressure ratings will be specified where required on the plans or as specified by the District Engineer.

1.06 DELIVERY, STORAGE AND HANDLING

Fire hydrants shall be delivered and stored in accordance with AWWA C210, AWWA C213, and AWWA C550. The port openings shall be covered with plastic, cardboard or wood while in transit and during storage in the field. These covers shall remain in place until the valve is ready to be installed. Fire hydrants shall not be stored in contact with bare ground. Fire hydrants shall not be stacked.

1.07 MASONRY RETAINING WALLS

If the above ground portion of the assembly is located within a cut slope or embankment fill, a masonry retaining wall shall be constructed on three sides around the assembly per drawing W-16. The face of wall shall be a minimum of one foot beyond the dimensional values of the concrete pad to be poured for the assembly as shown on the Standard Drawings. Use tan colored slump block and grout each cell solid. The concrete pad to be poured around the assembly shall extend to the face of the three walls and also to the adjacent sidewalk or curb. The District Engineer will decide whether the requirements of this paragraph are being followed by the Contractor. If in the opinion of the District Engineer modifications or changes are necessary, the work shall be performed as directed.

PART 2 MATERIALS

2.01 HYDRANTS

A. Fire hydrants and appurtenances shall be selected from the Approved Materials List.

B. Wet-barrel fire hydrants shall comply with AWWA C503 and these specifications unless otherwise indicated on the Standard Drawings.

C. All outlets shall be provided with National Standard Fire-Hose Threads. Outlets shall be equipped with brass or ductile iron caps with chains.

D. Wet-barrel fire hydrant flanges and appurtenant bury ells and spools shall incorporate a six-hole bolt pattern.

E. No Dry Barrel fire hydrants shall be used in Fallbrook Public Utility District.

2.02 BOLTS AND NUTS

Hydrant flange bolts and nuts shall be carbon steel conforming to ASTM A307and selected from the Approved Materials List. For working pressures below 300 psi, bolts shall be the Break Off type with the threads facing up and filled with silicone, for pressures above 300 psi, as specified on the plans or approved by the District Engineer.

2.03 CONCRETE

Concrete used for splash pads, thrust or anchor blocks shall be in accordance with Section 03300.

2.04 WARNING/IDENTIFICATION TAPE

Use marking tape consisting of one layer of aluminum foil laminated between two colored layers of inert plastic film. The lamination bond should be strong enough that the layers can not be separated by hand. Tape shall be a minimum of 5 mils thick and 6-inches wide. Elongation shall be a minimum of 600%. Tape shall bear a continuous, printed, message every 16 to 36-inches warning of the installation buried below. Tape shall be selected from the Approved Materials List.

2.05 FIELD PAINTING AND COATING

Field painting and coating materials shall be in accordance with Section 09900.

PART 3 EXECUTION

3.01 GENERAL

A. Fire hydrant assemblies shall be installed at locations shown on the Approved Plans or as directed by the fire department of jurisdiction in accordance with the Standard Drawings.

B. The location and port orientation of the Fire Hydrant shall be in accordance with the Standard Drawings and as required by the Fire Department.

C. Fire hydrant flange bolts shall be set with nuts on top; torque nuts uniformly and progressively in accordance with the manufacturer's recommendations.

D. Depending on location, fire hydrant assemblies may require protection posts or concrete retaining walls. When required by the District Engineer, or when shown on the Approved Plans, protection posts or retaining walls shall be installed in accordance with the Standard Drawings.

3.02 CONCRETE

Concrete thrust and anchor blocks shall be installed in accordance with Section 03300 and the Standard Drawings. Refer to Section 03300 for the minimum concrete curing time required.

3.03 WARNING/IDENTIFICATION TAPE

After the pipe zone and the first 12-inches in the trench zone have been backfilled and compacted, place the marking tape on the compacted backfill and center over the pipe. Run tape continuously along the trench and tie ends of tape together. Wrap marking tape around valve box extension pipes and continue along pipe.

3.04 DISINFECTION OF FIRE HYDRANT

The fire hydrant assembly shall be disinfected in accordance with Section 15041, as part of the process of disinfecting the main pipeline. The assembly valves shall be operated and the assembly flushed to completely disinfect all internal parts.

3.05 HYDROSTATIC TESTING

Fire hydrant assemblies shall be hydrostatically tested in accordance with Section 15044 in conjunction with the pipeline to which it is connected.

3.06 FIELD PAINTING AND COATING

The fire hydrant exterior shall be field painted in accordance with Section 09900.

END OF SECTION

SECTION 15112

BACKFLOW PREVENTION ASSEMBLIES

PART 1 GENERAL

1.01 DESCRIPTION

This section includes materials, installation, and testing of backflow prevention assemblies and detector check assemblies. Assemblies shall be installed at the locations as shown on the Drawings or as established in the field by the District Engineer.

1.02 REFERENCE STANDARDS

The publications listed below form part of this specification to the extent referenced and are referred to in the text by the basic designation only. Reference shall be made to the latest edition of said standards unless otherwise called for:

AWWA C511	Reduced Pressure Principal Backflow Prevention Assembly
ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250
ASTM A536	Standard Specification for Ductile Iron Castings
ASTM B584	Standard Specification for Copper Alloy Sand Castings for General Applications
ASTM B61	Standard Specification for Steam or Valve Bronze Castings
ASTM B62	Standard Specification for Composition Bronze or Ounce Metal Castings
ASTM A307	Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A563	Standard Specification for Carbon and Alloy Steel Nuts

1.03 RELATED WORK SPECIFIED ELSEWHERE

FPUD	Standard Drawings
Section 1 General Conditions 1.09	Record Drawings and Submittals
Section 02223	Trenching, Backfilling, and Compacting
Section 03300	General Concrete Construction
Section 09900	Painting and Coating
Section 15041	Disinfection of Piping
Section 15044	Pressure Testing of Piping

1.04 SUBMITTALS

A. Submit shop drawings in accordance with Standard Specification Section 01300.

B. Submit manufacturer's catalog data, descriptive literature, and assembly drawings. Show dimensions, materials of construction by specification reference and grade, linings, and coatings.

C. Submit manufacturer's certificate of compliance with AWWA C511 for reduced pressure principle backflow prevention assemblies.

1.05 MASONRY RETAINING WALLS

If the aboveground portion of the assembly is located within a cut slope or embankment fill, a masonry retaining wall shall be constructed on three (3) sides around the assembly per drawing W-16. The face of wall shall be a minimum of one (1) foot beyond the dimensional values of the concrete pad to be poured

for the assembly as shown on the Standard Drawings. Use tan colored slump block and grout each cell solid. The concrete pad to be poured around the assembly shall extend to the face of the three walls and also to the adjacent sidewalk or curb. The District Engineer will decide whether the requirements of this paragraph are being followed by the Contractor. If in the opinion of the District Engineer modifications or changes are necessary, the work shall be performed as directed.

1.06 PRIVATE PUMPING FACILITIES

The addition of a backflow prevention assembly to any given size water service assembly will reduce the available water service pressure. The owner may opt to install a larger size water service and backflow prevention assembly at their expense to provide adequate water service pressure. The District will not provide pumping facilities to increase water service pressure. Private pumping facilities shall be independent and located downstream of backflow prevention assemblies.

1.07 THERMAL EXPANSION

The addition of a backflow prevention assembly to a water service will constitute a closed system. The District will not provide thermal expansion facilities for this condition. Provide sufficient facilities for thermal expansion and check for proper operation of existing thermal or pressure relief devices.

PART 2 MATERIALS

2.01 MANUFACTURERS

Provide backflow prevention assemblies of the described type that are on the Approved Materials List.

2.02 BACKFLOW PREVENTERS

A. General: Backflow prevention devices shall be the same size as and never smaller than the upstream water service assembly. Where normal minimum water service pressure is less than 80 psi; the District may require the next larger assembly size.

B. Backflow prevention devices of the reduced pressure principle type shall conform to AWWA C511 with a maximum rated working pressure of 175 psi for operation on cold water pipelines. Provide two (2) independently acting check valves, an automatic pressure differential relief valve located between the check valves, two (2) resilient seated shutoff valves at each end of the assembly, and four (4) resilient seated test cocks so that a test of each check valve can be made. Check valves and the differential relief valve shall be constructed for servicing without removing the assembly from the line. Backflow prevention devices 2-inches and smaller (per drawing W-1) shall be bronze conforming to ASTM B61 or B62. Backflow prevention devices larger than 2-inches (per drawing W-2) shall have ductile iron bodies and covers conforming to ASTM A536 Grade 65-45-12. All internal working parts and relief valve shall be bronze conforming to ASTM B584 with stainless steel trim.

C. Backflow prevention devices 2-inches and smaller, shall be of the conventional in-line design for installation in a horizontal position with the relief valve discharging vertically down. Resilient seated shutoff valves and test cocks shall be full ported, bronze ball valves.

D. Backflow prevention devices 3-inches through 10-inches, shall be of the conventional in-line design for installation in a horizontal position. Shutoff valves shall be resilient seated gate valves with outside stem and yoke. Test cocks shall be full ported, bronze ball valves. Provide adjustable pipe supports to augment the installation to prevent flange damage.

2.03 DETECTOR CHECKS

A. Detector checks shall be sized according to the demands of the fire protection system.

B. Fire sprinkler systems will be protected by use of a Double Check Detector Assembly (DCDA) or Double Check Assembly-Type II (DCDA-II) for non health hazard conditions or by a Reduced Pressure Principle Detector Assembly (RPDA) or Reduced Pressure Principle Detector Assembly-Type II (RPDA-II) for health hazard conditions as determined by the District Engineer.

2.04 LINING AND COATING OF ASSEMBLIES

Coat interior and exterior ferrous surfaces of the backflow preventers and detector checks with fusion-bonded epoxy per Standard Specification Section 09900. Do not coat bronze, rubber, or stainless steel items.

2.05 VALVE END CONNECTIONS

A. Valves, 2-inches and smaller, shall have screwed ends. Valves, 2-1/2-inches and larger, shall have flanged ends.

B. Screwed ends shall conform to ANSI B1.20.1, NPT.

C. Flanged ends shall conform to ANSI B16.1, Class 125.

2.06 PACKING, O-RINGS, AND GASKETS

Unless otherwise stated; packing, O-rings, and gaskets shall be one of the following non-asbestos materials.

A. Teflon.

B. Kevlar aramid fiber.

C. Acrylic or aramid fiber bound by nitrile. Provide Garlock I' Bluegard," Klinger "Klingersil C4400," or District approved equal.

D. Buna-N (Nitrile).

2.07 BOLTS, NUTS AND GASKETS FOR FLANGES

A. Provide heavy hex, 307B cad plated carbon steel bolts and nuts for aboveground flanges and 316L stainless steel for buried flanges to be wrapped with polyethylene material.

B. Provide washers for each nut. Washers shall be of the same material as the nuts.

C. Gaskets shall be asbestos-free, full face, 1/16-inch or 1/8-inch thick, and shall be acrylic or aramid fiber bound with nitrile. Provide Garlock "Bluegard," Klinger "Klingersil C4400," or District approved equal. Gaskets shall be suitable for a water pressure of 500 psi at a temperature of 400ºF.

2.08 VALVE SETTERS

Provide valve setters to augment the installation of the compact design ("N" series) detector checks. Valve setters shall be constructed with integral support arms between the elbows to transfer thrust downstream. Construct valve setters of ductile iron conforming to ASTM A536 Grade 65-45-12. Coat

interior and exterior surfaces of the ductile iron with fusion-bonded epoxy. End connections shall be a combination of flanged ends and mechanical joints as shown on the Standard Drawings. Flanged ends shall conform to ANS B16.1 Class 125. Valve setters shall be Cla-Val Model VS, Febco Model 611, or District approved equal.

2.09 ADJUSTABLE PIPE SUPPORTS

Provide adjustable pipe support of welded steel construction with fusion-bonded epoxy coating. Locate the pipe supports under flanges or valve bodes as shown. Provide 2-inch galvanized steel pipe, cut to length, and place between the collar and base. Provide Material Resources "Standon Pipe Support Model S-89," or District approved equal.

2.10 GUARD POSTS

Provide guard posts shall be installed around the assembly per FPUD Standard Drawings W-13.

PART 3 EXECUTION

3.01 INSPECTION BEFORE INSTALLATION

Operate the shutoff valves and test cocks on the assemblies from closed to fully open, then close again before installing. Check for broken, cracked, or missing parts; malfunctioning stems; and faulty operation.

3.02 INSTALLATION

A. See Standard Specification Section 02223 for earthwork requirements. Use imported sand in the pipe base and pipe zone.

B. Install piping and riser section per the instructions contained in the appropriate Standard Specification for the material used.

C. Piping from the main to the backflow prevention assembly shall be placed level or on a continuous upward grade to avoid pocketing air. No outlets will be allowed in the piping between the main and the assembly. Trench backfilling shall not commence until the District Engineer has inspected this section of piping and is satisfied with the installation.

D. Install backflow prevention assemblies in a horizontal position, aboveground, and at the dimensions shown on the Standard Drawings. Locate the assemblies where shown or as established in the field by the District's Engineer. The District Engineer shall be the final authority as to location, installation, size, and type of backflow prevention assembly required.

E. Clean threaded joints by wire brushing or swabbing. Apply Teflon joint compound or Teflon tape to pipe threads before installing screwed valves. Joints shall be watertight.

F. Clean bolts, nuts and flange faces by wire brushing before installing flanged assemblies. Inspect gasket seating surfaces, gasket, each stud or bolt, nut, and washer. Replace any damaged item. Coat bolt shafts with waterproof gear grease or primer for wax tape coating prior to insertion in flange bolt holes. Do not apply grease or primer to threads. Lubricate threads of bolts and nuts with oil or graphite prior to installation. Assemble all bolts and nuts in a progressive diametrically opposite sequence, and torque with a calibrated torque wrench. All clamping torque shall be applied to the nuts only.

G. If flanges leak under pressure testing, loosen or remove the nuts and bolts, reset or replace the gasket, reinstall or retighten the bolts and nuts, and retest the joints. Joints shall be watertight. Replace galled, cracked, or distorted bolts and nuts.

H. After testing, coat exposed surfaces of bolts and nuts to be buried with waterproof gear grease or primer for wax tape coating.

3.03 INSTALLING POLYETHYLENE ENCASEMENT

Wrap ferrous pipe risers including base bends and valve setters with polyethylene material. Complete the wrap prior to placing concrete anchor blocks or concrete trust blocks on base bends or valve setters. Repair polyethylene material damaged during construction.

3.04 PLACING CONCRETE

Place concrete anchor blocks around the elbow of the pipe riser or valve setter. Where a thrust block is required, place concrete against the base bends and undisturbed ground. Place concrete back to back between the base bends. Allow concrete to set and be hard enough to be self-supporting. Place and compact trench backfill up to the subgrade of the concrete pad on grade. Pour a concrete pad on grade around the pipe risers. Concrete shall be per Standard Specification Section 03300.

3.05 SETTING GUARD POSTS

Position guard posts to protect the backflow prevention assembly. Locate posts as directed by the District Engineer. Excavate a hole 16-inches in diameter by 3-feet deep for each post. Set posts plumb, fill holes with concrete to 2-inches above finish grade, and crown to slope away from post. Posts shall be embedded a minimum of 3 feet in concrete. Fill posts with grout and crown top. Concrete shall be Class C per Standard Specification Section 03300.

3.06 PAINTING AND COATING

A. Paint aboveground surfaces of the pipe risers, elbows or bends, and adjustable pipe supports per Standard Specification Section 09900. Color of finish coat shall be red. Do not paint backflow prevention assemblies.

B. Paint above ground surfaces of the guard posts per Standard Specification Section 09900. Color of finish coat shall be OSHA Yellow.

3.07 PRESSURE TESTING

Test backflow prevention assemblies at the same time that the connecting pipelines are pressure tested. See Standard Specification Section 15044 for pressure testing requirements. Repair leaks in the backflow prevention assemblies and joints of the interconnecting piping and retest.

3.08 DISINFECTION

See Standard Specification Section 15041 for chlorination requirements.

3.09 INITIAL TESTING

Backflow prevention assemblies will not be placed into service until the appurtenance has been tested and certified by a certified backflow tester. The results shall be submitted to the District Engineer for final approval.

END OF SECTION

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SECTION 15150

WATER METERS

PART 1 GENERAL

1.01 DESCRIPTION

This section describes the purchase, materials, installation and testing of meter assemblies.

1.02 REFERENCE STANTDARDS

AWWA C700	Cold Water Meters – Displacement Type, Bronze Main Case
AWWA C701	Cold Water Meters – Turbine Type, for Customer Service
AWWA C702	Cold Water Meters – Compound Type
AWWA C703	Cold Water Meters – Fire Service Type

1.03 RELATED WORK SPECIFIED ELSEWHERE

FPUD Section 01	GENERAL CONDITIONS
FPUD Section 02	DESIGN MANUAL
FPUD Section 03	TECHNICAL MANUAL
Section 02223	Trenching, Backfilling and Compaction
Section 03300	Cast-in-Place Concrete
Section 09900	Painting and Coating
Section 15057	Copper Tubing, Brass, and Bronze Pipe, Fittings
Section 15056	Ductile-Iron Pipe and Fittings
Section 15100	Valves

1.04 APPROVED MANUFACTURERS

A. All meters AND Meter Boxes shall be supplied by the District.

B. All service line materials shall be from the Approved Materials List, or approved equal.

1.05 WATER METER SERVICE LINE INSTALLATION

A. Installed by District

1. The developer/customer may chose to have District install the service lines and meters.

2. The developer/customer shall pay all fees for the installation of service lines and meters in accordance with governing District ordinance(s)

B. Installed by Developer/Customer

1. Installation shall be performed by an approved underground contractor, Class A or C-34. Certified welder for steel waterline shall be employed to Hot Tap to pipeline. Reference of experience may be required.

2. All service runs and other appurtenances shall be furnished and installed by the developer/customer. Meters and meter boxes shall be furnished by the District and installed by the developer/customer. Connection fees will be in accordance with governing District ordinance(s). All water services shall be constructed in accordance with the District current Standard Drawings, applicable to the size, type and intended service of the installed water service.

3 The developer/customer shall conduct a pre-construction conference with the District Engineer prior to commencement of water service construction and shall pay all applicable fees and obtain written approval for water service construction in accordance with current District ordinance(s) prior to commencement of construction. Failure to obtain written approval to construct shall constitute a breach of District protocol and may result in the inability of the District to provide water.

4 The developer/customer shall deposit an amount with the District for inspection of the entire water service installation prior to commencement of work. NO water service(s) shall be constructed or placed into service without District inspection. All components of the water service installation shall be submitted to the District Engineer for review and approval, and shall meet the current District standards and the requirements of these specifications. Failure to pay inspection fees or obtain proper District inspection will result in the District inability to provide water supply to all un-inspected water service installations.

5 The developer and/or customer are responsible for coordinating inspection services through the District for all water service installations. The developer and/or customer shall notify the District Engineering Inspector a minimum of five (5) working days prior to starting work; and two (2) working days during the construction for inspections. Failure to provide the sufficient notice to the District Engineering Inspector to obtain inspection services may lead to project delays for which the District will not be responsible. Water services installed without proper District inspection shall be uncovered, removed and reinstalled with proper inspection by the developer and/or customer at the developer and/or customer's expense. **No exception will be made to the requirement for District inspection services.**

6 The developer and/or customer is responsible for the installation of all water service components (except the meter) in accordance with District standards, including but not limited to the couplings, customer service valve, double check valve, and RP device (as appropriate).

7 Subsequent applications for permanent service shall be made in accordance with the District's Rules and Regulations.

PART 2 MATERIALS

2.01 SYNTHETIC METER BOXES

Synthetic meter boxes shall be green in color and shall be manufactured by Carson or approved equal. Sizing of the meter box shall be determined by the current District standard for the sizing of the meter installation and shall be supplied by the District.

2.02 COPPER, BRASS, AND BRONZE PIPE, FITTINGS, AND APPURTENANCES

All service connection, by-pass piping, and appurtenances necessary for proper installation of the water service and meter shall conform to Section 15057 and the District Standard Drawing(s).

2.03 DUCTILE-IRON PIPE AND FITTINGS

All piping for meter assemblies 3-inch and larger shall be ductile iron conforming to the requirements of Section 15056.

2.04 MANUAL VALVES

All manual valves shall conform to the requirements of Section 15100. All manual angle stop valves shall be lockable in the closed position. Customer valves shall be lockable in the closed position.

PART 3 EXECUTION

3.01 METER INSTALLATION

A. All meters and Radios will be provided by the District.

B. All meter installations shall conform to District Standard Drawing(s), W-1, W-2, W-5,

3.02 METER PROTECTION

A. Reduced Pressure back flow devices shall be installed in accordance with District Ordinance conforming to District Standard Drawing(s), W-1A, or W-2A.

B. All meter installations where the maximum static pressure exceeds 175 psi and a Reduced Pressure backflow device is required the installation of a pressure regulator shall be located between the meter and the RP backflow device. The pressure regulator shall be adjusted to 150 psi. Pressure regulators shall be manufactured by Wilkins or approved equal.

3.03 EXCAVATION AND BACKFILL

Excavation and backfill for the meter installation shall be in accordance with Section 02223, and compaction reports shall submitted to the District.

3.04 SERVICE PIPING

A. All piping for service lines shall be installed in conformance with Section 15057.

B. All service lines shall be perpendicular to the District mainline pipe.

C. The piping for all service installations 3-inch and larger shall be in accordance with Section 15056 and the applicable District Standard Drawing.

D. All buried piping for service laterals shall be wrapped with 10 mil tape or sleeved in polyethylene.

E. Hot taps required for service lateral installations shall be coordinated with the District Engineer and shall not be constructed until appropriate District fees have been paid and inspection services have been scheduled. **NO UNAUTHORIZED HOT TAPPING OF DISTRICT PIPELINES IS ALLOWED WITHOUT PRIOR WRITTEN APPROVAL AND AUTHORIZATION BY THE DISTRICT ENGINEER.** Hot taps shall be constructed and installed in accordance with current District standards.

3.05 METER VAULT

A. All meter vaults (boxes) shall be installed in accordance with current District standard. Meter Box (Green) will be supplied by the District as manufactured by Carson or approved equal.

B. Meter boxes shall be installed by the developer/customer, unless otherwise noted. Sizes shall be as specified on the standard drawings for the various sizes and types of services. Any meter boxes to be requested for review as an equal must have identical lid, color, and inside box dimensions.

C. Meter boxes shall be set true to line and to the grade of the top of the curb, sidewalk, or surrounding graded area.

D. Meter boxes are not to be set until fine grading or landscape grading has been completed by the developer/customer.

3.06 CONCRETE WORK

All thrust blocks, foundations, and supports shall be of the sizes shown in the applicable standard drawings and conform to Section 03300.

3.07 VALVES

All valves installed shall conform to the requirements of Section 15100.

3.08 PAINTING AND COATING

A. All exposed and/or buried piping shall be painted or coated in accordance with Section 09900.

B. The meter lids on all non-potable water services shall be painted in accordance with Section 09900.

3.09 TESTING

All meter services shall be hydrostatically pressure tested during the testing of pipeline in accordance with Section 15044.

END OF SECTION