



Standard Specifications for Potable Water, Recycled Water and Sewer Facilities

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WATER AGENCIES' STANDARDS

STANDARD SPECIFICATIONS

SECTION 02223 TRENCHING, EXCAVATION, BACKFILL AND COMPACTION

PART 1 GENERAL

1.01 DESCRIPTION

This section includes materials, testing and installation for trench excavation, backfill, and compaction of piping, conduit, manholes and vaults.

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 C 131	-	Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 150	-	Portland Cement
ASTM D 75	-	Practice for Sampling Aggregates
ASTM D 1556	-	Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	-	Test Method for Moisture-Density Relations of Soils Using a Modified Effort
ASTM D 2419	-	Test Method for Sand Equivalent Values of Soil and Fine Aggregate
ASTM D 2922	-	Test Method for Density of Soil in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	-	Test Method for Water Content of Soil and Rock in Place by Nuclear Methods
ASTM D 3776	-	Test Method for Mass Per Unit Area (Weight) of Woven Fabric
ASTM D 4253	-	Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Plate
ASTM D 4254	-	Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
ASTM D 4632	-	Test Method for Grab Breaking Load and Elongation of Geotextiles
ASTM D 4751	-	Test Method for Determining the Apparent Opening Size of a Geotextile
CAL-OSHA	-	Title 8 General Industry Safety Orders

1.03 RELATED WORK SPECIFIED ELSEWHERE

WAS Standard Drawings

WAS Standard Specifications 01000, 02202, 03461, 03462, 15000, 15044, 15056, 15061, 15064, and 15065

1.04 GEOTECHNICAL TESTING

The Developer or Contractor shall engage the services of a geotechnical engineering firm or individual licensed in the State of California to monitor soil conditions during earthwork, trenching, bedding, backfill and compaction operations. Sampling and testing procedures shall be performed in accordance with the Reference Standards and as follows:

- A. The soils technician shall be present at the site during all backfill and compaction operations. Failure to have the soils technician present will subject such operations to rejection.
- B. Density and optimum moisture content of soil shall be determined by the use of the sand cone method, ASTM D 1556, or nuclear density gauge method, ASTM D 2922 & D 3017. Since the composition of the pipe and the walls of the trench have an effect on the nuclear density gauge output, a minimum of 25% of the density and optimum moisture tests shall be made using the sand cone method.
- C. Determine laboratory moisture-density relations of existing soil by ASTM D 1557, Method C and/or D (formerly ASTM D 4253 and ASTM D 4254).
- D. Determine the relative density of cohesionless soils by ASTM D 1557, Method C and/or D (formerly ASTM D 4253 and ASTM D 4254).
- E. Sample backfill material by ASTM D 75.
- F. Express "relative compaction" as a percentage of the ratio of the in-place dry density to the laboratory maximum dry density.

A report of all soils tests performed shall be stamped and signed by the soils firm or individual and shall be submitted by the Contractor prior to the filing of the Notice of Completion by the District. The report shall document the sampling and testing of materials, the location and results of all tests performed, and shall certify that materials and work are in compliance with this specification.

1.05 PIPE ZONE

The pipe zone includes the full width of the trench from 150mm (6") below the bottom of the pipe to 300mm (12") above the top of the pipe and extends into manhole or vault excavations to the point of connection to or penetration of such structure.

1.06 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 in paved areas, or to the existing surface in unpaved areas, and extends into manhole or vault excavations above the pipe zone.

1.07 PAVEMENT ZONE

The pavement zone includes the concrete or asphalt concrete pavement and aggregate base section placed over the trench zone and extends into manhole or vault excavations above the trench zone.

1.08 PROTECTION OF EXISTING UTILITIES AND FACILITIES

The Contractor shall be responsible for the care and protection of all existing utilities, facilities and structures that may be encountered in or near the area of the work in accordance with Section 01000.

1.09 PROTECTION OF EXISTING LANDSCAPING

The Contractor shall be responsible for the protection of all trees, shrubs, fences, and other landscape items adjacent to or within the work area in accordance with Section 01000.

1.10 ACCESS

The Contractor shall provide continuous, unobstructed access to all driveways, water valves, hydrants, or other property or facilities within or adjacent to the work areas.

1.11 SAFETY

- A. Protection of workers within trenches shall be as required by the California Labor Code and in accordance with Section 01000.
- B. All excavations shall be performed in a safe manner and shall be protected and supported in accordance with CAL-OSHA regulations.
- C. Barriers and traffic delineators shall be placed in accordance with the requirements of the agency having jurisdiction.

1.12 BLASTING

Blasting for excavation shall not be performed without the written permission of the District. Procedures and methods of blasting shall conform to all Federal, State and local laws and ordinances.

1.13 PIPE JACKING

Pipe jacking may be permitted in accordance with Section 15125. District approval is required in advance of such operations.

1.14 EXCESS EXCAVATED MATERIAL

- A. The Contractor shall remove and legally dispose of all excess excavated material and demolition debris.
- B. It is the intent of these specifications that all surplus material shall be legally disposed of by the Contractor. Before acceptance of the work by District, the Contractor shall provide the District with written releases signed by all property owners with whom the Contractor has entered into agreements for disposing of excess excavated material, absolving the District from any liability connected therewith.

1.15 FILTER FABRIC

Filter fabric shall be used when excessively wet, soft, spongy, or similarly unstable material is encountered or in areas of suspected high groundwater in accordance with the soils technician's recommendation and the approval of the District Engineer.

1.16 CHANGES IN LINE AND GRADE

In the event obstructions not shown on the plans are encountered during the progress of the work, and which will require alterations to the plans, the District Engineer shall have the authority to change the plans and order the necessary deviation from the line and grade, in accordance with Section 01000. The Contractor shall not deviate from the specified line and grade without prior written approval by the District Engineer.

1.17 HYDROSTATIC TESTING

Pre-testing of the piping system may be performed for the Contractor's convenience at any time. However, the final hydrostatic pressure test shall be as described in Section 15044.

PART 2 MATERIALS

2.01 GENERAL

The Contractor shall furnish backfill material as specified below. All materials used in and above the pipe zone shall be capable of attaining the required relative density.

2.02 IMPORTED GRANULAR MATERIAL - PIPE ZONE

Imported Granular Material shall be used within the Pipe Zone for installations of all pressure pipe and tubing.

The Imported Granular Material shall be quarry waste (decomposed granite) free from organic matter. Material shall have a sand equivalent value of not less than 30 per ASTM D 2419, a coefficient of uniformity of 3 or greater, and shall conform to the following gradation:

<u>U.S. Standard Sieve Size</u>	<u>Percent Passing By Weight</u>
25mm (1")	100
19mm (3/4")	90 – 100
4.75mm (No. 4)	50 – 95
600µm (No. 30)	25 – 45
75µm (No. 200)	3 – 15

Native materials may not be used in lieu of Imported Granular Material within the Pipe Zone unless such native materials meet all of the requirements specified above and specific written permission has been obtained from the District Engineer.

2.03 CRUSHED ROCK - PIPE ZONE

Crushed Rock shall be used within the Pipe Zone for installations of all non-pressure pipe. Crushed rock shall be clean crushed stone free of organic matter. Crushed rock shall be certified to contain less than 1% asbestos by weight or volume and shall conform to the following gradation:

<u>U. S. Standard Sieve Size</u>	<u>Percent Passing By Weight</u>
25mm (1")	100
19mm (3/4")	90-100
12.5mm (1/2")	30-60
9.5mm (3/8")	0-20
4.75mm (No. 4)	0-5
2.36mm (No. 8)	----

In addition, crushed rock for use within the pipe zone shall meet or exceed the following requirements for resistance to abrasion or impact as measured using ASTM Test Method C 131, Test Sample Grading B:

100 Revolutions:	15% Maximum Loss by Weight
500 Revolutions:	52% Maximum Loss by Weight

2.04 IMPORTED GRANULAR MATERIAL - TRENCH ZONE

Imported Granular Material shall be used within the Trench Zone for installations of all pressure pipe and tubing and all non-pressure pipe.

Imported Granular Material for use within the Trench Zone shall conform in all ways to Imported Granular Material specified for use within the Pipe Zone.

Native materials may not be used in lieu of Imported Granular Material within the Trench Zone unless such native materials meet all of the requirements specified for Imported Granular Material within the Pipe Zone and specific written permission has been obtained from the District Engineer.

2.05 SAND-CEMENT SLURRY

Sand-cement slurry shall consist of two sacks, 85.3kg (188 pounds) of Portland cement per cubic yard of sand and sufficient moisture for workability. District approval is required for use of sand-cement slurry as a backfill material.

2.06 TRENCH PLUGS

Trench plugs consisting of compacted Imported Granular Material or sand-cement slurry shall be installed on piping systems that are backfilled with crushed rock.

2.07 FILTER FABRIC

Filter fabric shall be manufactured from polyester, nylon, or polypropylene. Material shall be of non-woven construction and shall meet the following requirements:

Grab tensile strength (ASTM D 4632): 45.4kg (100 lbs) minimum for a 25mm (1") raveled strip

Weight (ASTM D 3776): 152.6g/m² (4.5 oz./yd²)

Apparent opening size (ASTM D 4751): 0.150mm (0.006")

PART 3 EXECUTION

3.01 CLEARING AND GRUBBING

- A. Areas where work is to be performed shall be cleared of all trees, shrubs, rubbish, and other objectionable material of any kind, which, if left in place, would interfere with the proper performance or completion of the contemplated work, would impair its subsequent use, or would form obstructions therein.
- B. Organic material from clearing and grubbing operations will not be incorporated in the trench backfill and shall be removed from the project site or retained and incorporated into the topsoil.

3.02 PAVEMENT, CURB, AND SIDEWALK REMOVAL

Bituminous or concrete pavements, curbs, and sidewalks shall be removed and replaced in accordance with the requirements of the agency having jurisdiction.

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 excavations or other parts of the work.
- B. Dewatering shall be performed by methods that will ensure a dry excavation and preservation of the final lines and grades of the bottoms of excavations. Dewatering methods may include well points, sump points, suitable rock or gravel placed as pipe bedding for drainage and pumping, temporary pipelines, or other means, all subject to the approval of the District Engineer. The cost of all dewatering activities shall be borne by the Developer or Contractor.
- C. Sewer systems shall not be used as drains for dewatering trenches or excavations, nor for disposal of collected or accumulated groundwater, without the approval of the agency of jurisdiction.
- D. Concrete shall not be poured in water, nor shall water be allowed to rise around concrete or mortar until it has set at least four hours.

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

3.04 SHORING AND SHIELDING

- A. The Contractor's design and installation of shoring shall be consistent with the rules, orders, and regulations of CAL-OSHA.
- B. Excavations shall be shored, sheeted, and supported such that the walls of the excavation will not slide or settle and all existing improvements of any kind, either on public or private property, will be fully protected from damage.
- C. The sheeting and shoring shall be arranged so as not to place any stress on portions of the completed work until the general construction has proceeded far enough to provide ample strength.
- D. Care shall be exercised in the moving or removal of trench shields, sheeting, and shoring to prevent the caving or collapse of the excavation faces being supported.

3.05 CORRECTION OF OVEREXCAVATION

Overexcavations shall be corrected by backfilling with approved imported granular material or crushed rock, compacted to 90% relative compaction, as directed by the District Engineer.

3.06 FOUNDATION STABILIZATION

- A. When unsuitable soil materials are encountered, the unsuitable material shall be removed to the depth determined necessary in the field by the Soils Technician, and as acceptable to the District Engineer. The sub-grade shall be restored with compacted Imported Granular Material or crushed rock as recommended by the Soils Technician. Place the appropriate bedding or base material on this restored foundation.
- B. When rock encroachment is encountered, the rock shall be removed to a point below the intended trench or excavation sub-grade as determined necessary in the field by the Soils Technician, and as acceptable to the District Engineer. The sub-grade shall be restored with compacted Imported Granular Material as recommended by the Soils Technician. Place the appropriate bedding or base material on this restored foundation.
- C. When excessively wet, soft, spongy, or similarly unstable material is encountered at the surface upon which the bedding or base material is to be placed, the unsuitable material shall be removed to the depth determined necessary in the field by the Soils Technician, and as acceptable to the District Engineer. Restore the trench with crushed rock enclosed in filter fabric as directed by the District Engineer. Larger size rocks, up to 75 mm (3"), with appropriate gradation, may be used if recommended by the Soils Technician. Place the appropriate bedding or base material on this restored foundation.

3.07 TRENCH EXCAVATION AND PLACEMENT OF BEDDING

- A. Excavate the trench to the lines and grades shown on the drawings with allowance for 150mm (6") of pipe bedding material. The trench section shall be as shown on the Standard Drawings.

- B. The maximum length of open trench shall be 152m (500') except by permission of the District, City or County. The distance is the collective length at any location, including open excavation and pipe laying, which has not been backfilled to the elevation of the surrounding grade.
- C. Trench walls shall be sloped or shored per the requirements of CAL-OSHA.
- D. The trench bottom shall be graded to provide a smooth, firm, and stable foundation that is free from rocks and other obstructions.
- E. Place the specified thickness of bedding material over the full width of the trench. Grade the top of the pipe base ahead of the pipe laying to provide a firm, uniform support along the full length of pipe.
- F. Excavate bell holes at each joint to permit proper assembly and inspection of the entire joint.
- G. Trenches for main pipelines and all appurtenances shall be backfilled with the materials and methods as specified for the Pipe Zone, Trench Zone and Pavement Zone.
- H. Trench widths shall be in accordance with the Standard Drawings.
- I. Trench depth shall be as required to install pipelines in accordance with the Approved Plans and the Water Agencies' Design Guide. Unless shown otherwise on the Approved Plans, the minimum depth of cover for pipelines shall be as follows:

<u>Pipeline Type</u>	<u>Minimum Cover Required</u>
Potable Water	0.91m (36")
Recycled Water	1.22m (48")
Sewer	1.52m (60")

- J. Final street sub-grade shall be established prior to the excavation of pipeline trenches. Minimum cover above pipe shall be 24" for hydrotesting.

3.08 MANHOLE AND VAULTS

- A. The Contractor shall prepare an excavation large enough to accommodate the structure and permit grouting of openings and backfilling operations. The walls of the excavation shall be sloped or shored per the requirements of CAL-OSHA.
- B. Manholes and vaults shall be placed at the location and elevation shown on the plans, on undisturbed soils and 150mm (6") of compacted crushed rock base.
- C. Manhole and vault excavations shall be backfilled with the materials and methods as specified for the Pipe Zone, Trench Zone and Pavement Zone.

3.09 COMPACTION REQUIREMENTS

- A. Compaction shall be accomplished by mechanical means. Consolidation by water settling methods such as jetting or flooding is prohibited.

- B. If the backfill fails to meet the specified relative compaction requirements; the backfill shall be reworked until the requirements are met. All necessary excavations for density tests shall be made as directed by the Soils Technician, and as acceptable to the District Engineer. The requirements of the Agency having jurisdiction shall prevail on all public roads.
- C. Compaction tests shall be performed at random depths, and at random intervals not to exceed 45m (150'), as directed by the Soils Technician or District Engineer.
- D. Relative compaction shall be determined by the impact or field compaction test made in accordance with ASTM D 1557 Procedure C.
- E. Unless otherwise shown on the drawings or otherwise described in the specifications for the particular type of pipe installed, relative compaction in pipe trenches shall be as follows:
 - 1. Pipe zone - 90% relative compaction.
 - 2. Trench zone - 90% relative compaction.
 - 3. Structural section in paved areas - per agency requirements, 95% minimum.
 - 4. Imported Granular Material for over excavation or foundation stabilization - 90% relative density.
- F. All excavations are subject to compaction tests.

3.10 TRENCH PLUGS

Trench plugs shall be installed at 60m (200') intervals along the entire length of piping systems. Trench plugs shall be 3m (10') in length and shall encompass the entire pipe zone. Additional trench plugs may be required as directed by the District Engineer.

3.11 PIPE ZONE BACKFILL

- A. Care shall be taken in placing the imported granular backfill material simultaneously around the main pipeline and appurtenance pipes so that the pipe barrel is completely supported and that no voids or uncompacted areas are left beneath the pipe or on the sides of the pipe. Care shall be taken to place material simultaneously on both sides of the pipe to prevent lateral movement. This area shall be mechanically compacted to attain 90% relative density. Care shall be taken when compacting appurtenance laterals 50mm (2") and smaller to prevent the crushing or denting of the copper lateral. Additional lifts of 300mm (12") or less thickness may be required on 400mm (16") or larger diameter pipe to attain complete support of the haunch area. Soils tests may be taken on this layer of backfill.
- B. After the spring line backfill has been approved by the Soils Technician, backfill of the remainder of the Pipe Zone may proceed. Do not drop sharp, heavy pieces of material directly onto the pipe or the tamped material around the pipe.
- C. Place and compact the imported granular material at a maximum of 300mm (12") lifts. Compact all material placed in the Pipe Zone by mechanical methods. Sand cone tests shall be taken on this layer of backfill.

- D. The use of a backhoe-mounted compaction wheel is prohibited within the pipe zone to 300mm (12") above the top of the pipe.
- E. Under no circumstances shall consolidation by water settling or water-setting methods (i.e. jetting, diking, etc.) be permitted.

3.12 TRENCH ZONE BACKFILL

- A. After the Pipe Zone material has been placed, compacted, approved by the Soil Technician and accepted by the District Engineer, backfill in the Trench Zone may proceed.
- B. Compaction using vibratory equipment, tamping rollers, pneumatic tire rollers, or other mechanical tampers shall be performed with the type and size of equipment necessary to accomplish the work. The backfill shall be placed in horizontal layers of such depths as are considered proper for the type of compacting equipment being used in relation to the backfill material being placed. Each layer shall be evenly spread, properly moistened, and compacted to the specified relative density. The Contractor shall repair or replace any pipe, fitting, manhole, or structure damaged by the installation operations as directed by the District Engineer.

3.13 PAVEMENT ZONE BACKFILL AND RESTORATION

- A. After the Trench Zone material has been placed, compacted, approved by the Soil Technician, and accepted by the District Engineer; backfill in the Pavement Zone may proceed as necessary in accordance with the requirements of the agency having jurisdiction.
- B. Replace bituminous and concrete pavement, curbs, and sidewalks removed or damaged during construction in accordance with the requirements of the agency having jurisdiction.

END OF SECTION

WATER AGENCIES' STANDARDS

STANDARD SPECIFICATIONS

SECTION 15041 DISINFECTION OF PIPING

PART 1 GENERAL

1.01 DESCRIPTION

This section describes requirements for disinfection by chlorination of potable and recycled 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 B300	-	Hypochlorites
AWWA B301	-	Liquid Chlorine
AWWA C651	-	Disinfecting Water Mains

1.03 RELATED WORK SPECIFIED ELSEWHERE

AWWA Standard Methods for the Examination of Water and Waste Water
WAS Standard Specifications 15000, 15044, 15056, 15057, 15061, and 15064

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 pipelines 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 written disinfection and dechlorination plan, including all methods and equipment to be used, shall be signed by the person responsible for performing the work and shall be submitted to the District Engineer for approval prior to starting disinfection operations.

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) 1910.120 Hazardous Waste Operations and Emergency Response, CFR 49.172 Hazardous Materials Regulations, and the General Industry Safety Orders of the California Code of Regulations, Title 8, Section 5194.

1.07 CONCURRENT DISINFECTION AND HYDROSTATIC TESTING

The specified disinfection of the pipelines may not be performed concurrently with the hydrostatic testing in accordance with 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. Connection to existing mains shall be performed in accordance with Section 15000.

PART 2 MATERIALS

2.01 LIQUID CHLORINE (GAS)

- A. Liquid chlorine contains 100-percent available chlorine and is packaged in steel containers in net weights of 68.1kg (150 lb.) or 907.2kg (1 ton).
- B. Liquid chlorine shall be used with appropriate gas flow chlorinators, heaters, and injectors to provide a controlled, high-concentration solution feed to the water. The chlorinators and injectors shall be the vacuum-operated type.

2.02 SODIUM HYPOCHLORITE (LIQUID)

Sodium hypochlorite is available in liquid form in glass or plastic containers, ranging in size from 0.95 L (1 Qt.) to 18.93 L (5 Gal). The solution contains approximately 10% to 15% available chlorine.

2.03 TABLET OR GRANULAR HYPOCHLORITE

Tablet or granular hypochlorite shall not be used at any time.

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 percent 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 District Engineer.

3.02 METHODS

- A. Liquid Chlorine (Gas)
 - 1. Only vacuum-operated equipment shall be used. Direct-feed chlorinators, which operate solely from gas pressure in the chlorine cylinder, shall not be permitted. The equipment shall incorporate a backflow prevention device at the point of connection to the potable water source used to fill the line being tested.
 - 2. The chlorinating agent shall be applied at the beginning of the system to be chlorinated and shall be injected through a corporation stop, a hydrant, or other approved connection to ensure treatment of the entire system being disinfected.
 - 3. Only a certified, licensed chlorination and testing contractor shall perform gas chlorination work. The chlorination contractor must also possess a Grade II Treatment Plant Operator Certification from the State of California if required by the District Engineer.
- B. 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 in 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. Water trucks, pumping equipment, piping, appurtenances and all other equipment in contact with potable water shall be disinfected prior to use.

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 insure 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. Prior to disinfection, new pipelines shall be drained as directed by the District Engineer. The pipeline shall then be filled with potable water at a rate not to exceed 1,135 liters per minute (300 GPM) or a velocity of 0.3m per second (1 foot per second), whichever is less, and then flushed at a minimum velocity of 0.76 meters per second (2.5 feet per second) until the turbidity level of the water in the new pipeline(s) is less than or equal to 0.5 NTU or is equal in turbidity to the source water, if the source water turbidity is greater than 0.5 NTU.
- B. Disinfection shall result in an initial total chlorine concentration of 50-mg/l. 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 a sufficient length of time to insure 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 District Engineer 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.) Addition of disinfection solution after the initial charging of the line shall be made by either the liquid chlorine (gas) method, or the sodium hypochlorite method as directed by 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 decreased 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 0.76 meters per second (2.5 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 and the turbidity level is 0.5 NTU's or less or as otherwise directed by the District Engineer. (Note the limitations for discharge of chlorinated water outlined below.)

- G. The District Engineer will perform bacteriological sampling and testing as specified herein.

3.04 DISCHARGE OF CHLORINATED WATER

- A. Indiscriminate onsite disposal or discharge to sewer systems, storm drains, drainage courses or surface waters is prohibited. It shall be the responsibility of the Developer to file a Notice of Intent and obtain a General Waste Discharge Requirements Permit for Discharges of Hydrostatic Test Water and Potable Water to Surface Waters, Storm Drains or Other Conveyance Systems, San Diego Region (Hydrostatic Test Permit) for any discharge of hydrostatic test water or other potable water. The Contractor shall be solely responsible to evaluate, obtain and comply with the provisions of the Hydrostatic Test Permit, including any monitoring and reporting as may be required. The Contractor shall comply with all requirements of the State Water Resources Control Board and the San Diego Regional Water Quality Control Board. The Contractor shall provide copies of all reports and monitoring information to the District Engineer.

Failure to comply with the Hydrostatic Test Permit is a violation of federal and state law. The Contractor hereby agrees to indemnify and hold harmless the District, its Board members, officers, agents, employees and authorized volunteers from and against any and all claims, demands, losses or liabilities of any kind or nature which District, its Board members, officers, agents, employees and authorized volunteers may sustain or incur for noncompliance with the Hydrostatic Test Permit arising out of or in connection with the Project.

- B. The environment to which the chlorinated water is to be discharged shall be examined by the Developer and the Private Engineer. Where necessary, federal, state and local regulatory agencies should be contacted to determine special provisions for the disposal of chlorinated water. Any indication that the discharge of chlorinated water may cause damage to the environment shall require the neutralizing of the chlorine residual by means of a reducing agent in accordance with AWWA C651 and the requirements of this specification.
- C. In locations where chlorine neutralization is required, the reducing agent shall be applied to the water as it exits the piping system. The Developer 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

30-Day Average	-	0.002 mg/l
Average Daily Maximum	-	0.008 mg/l
Instantaneous Maximum	-	0.02 mg/l

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

- D. In locations where no hazard to the environment is evident based on the joint examination described above, the chlorinated water may be broadcast for dust control on the surface of the immediate site. Care shall be exercised in broadcasting the water to prevent runoff.

3.05 BACTERIOLOGICAL TESTING

After disinfection has been performed as detailed herein, the District Engineer will perform bacteriological sampling and testing of all new system installations. The testing methodology employed by the District Engineer shall be as set forth in "Standard Methods for the Examination of Water and Waste Water" (current edition). Testing requirements are as set forth in the California Domestic Water Quality and Monitoring Regulations and in accordance with current requirements for surface water testing.

- A. The District Engineer will take samples on two consecutive days 24 hours apart. No flushing is allowed between samples. The days of the test shall be determined by the District Engineer.
- B. Sample locations shall be determined by the District Engineer and shall be taken through the length of the new pipeline(s) at locations not more than 365m (1,200') apart. In addition, samples shall be taken at all branches and dead ends.
- C. All samples must pass the following tests:
 - 1. Coliform Bacteria Test: No positive samples allowed.
 - 2. Heterotrophic Plate Count (HPC) Test: No more than 500 colony-forming units allowed in any sample. The requirement for HPC testing may be waived at the sole discretion of the District Engineer.

3.06 RE-DISINFECTION

- A. If any first-day samples fail the Coliform Bacteria or HPC Tests, the entire pipeline(s) will be re-flushed by the Contractor and re-sampled on two consecutive days 24 hours apart as specified herein.
- B. If any second-day samples fail the Coliform Bacteria or HPC Tests (after passing the first-day tests), the pipeline(s) shall be re-flushed and re-sampled until samples collected on two consecutive days, 24 hours apart, have passed all tests.
- C. If, after the re-flushing procedures described above are performed, the new pipeline(s) continue to fail either the Coliform Bacteria or HPC Tests, the pipeline(s) shall be re-disinfected, re-flushed, and re-sampled. These procedures shall continue until satisfactory results are obtained.
- D. All re-disinfection, re-flushing and re-sampling required shall be at the Contractor's expense.

3.07 CONNECTING NEW PIPELINES TO EXISTING PIPELINES

- A. Upon successful completion of Bacteriological Testing, Contractor shall schedule connections to existing pipelines within 10 working days or as otherwise required by the District Engineer. If the Contractor exceeds the 10 working day time frame to schedule connections to existing pipelines, additional sampling and testing may be required at the discretion of the District Engineer.

- B. Upon completion of connections to existing pipelines, the District will activate and flush the pipeline and again take samples. If samples fail, the District will re-sample at the failed test location(s). If the re-sample does not produce satisfactory results, the newly-installed pipeline shall be disconnected from the existing pipeline(s) at the discretion of the District Engineer. The new pipeline shall then be re-disinfected, re-flushed and re-sampled as specified herein at the Contractor's expense.

3.08 DISINFECTION AT SHORT-LENGTH TIE-INS

Pipes, fittings, valves and all other components incorporated into connections to the District's existing system with an assembly length of 6m (20') or less 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 and tested as directed by the District Engineer. Failure to pass Bacteriological Testing will require that new facilities be adequately isolated from existing facilities and re-disinfected and re-tested until the new facilities pass the required tests. Costs for additional disinfection, sampling and testing shall be paid for by Contractor. Alternate methods such as "predisinfection" prior to installation in accordance with AWWA C651 may be required at the discretion of the District Engineer.

END OF SECTION

WATER AGENCIES' STANDARDS

STANDARD SPECIFICATIONS

SECTION 15061 CEMENT-MORTAR LINED AND COATED STEEL PIPE AND SPECIALS

PART 1 GENERAL

1.01 DESCRIPTION

This section includes materials, design, fabrication, and installation of cement-mortar lined and coated steel pipe and specials.

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 In. (150mm) and Larger
AWWA C205	-	Cement-Mortar Protective Lining and Coating for Steel Water Pipe 4 In. (100mm) and Larger - Shop Applied
AWWA C206	-	Field Welding of Steel Water Pipe
AWWA C207	-	Steel Pipe Flanges For Waterworks Service – Sizes 4 In. Through 144 In. (100mm Through 3,600mm)
AWWA C208	-	Dimensions for Fabricated Steel Water Pipe Fittings
AWWA C217	-	Petrolatum and Petroleum Wax Tape Coatings for the Exterior of Connections and Fittings for Steel Water Pipelines
AWWA C606	-	Grooved and Shouldered Joints
AWWA M11	-	Steel Pipe - A Guide for Design and Installation
ASTM A 47/A 47M	-	Standard Specification for Ferric Malleable Iron Castings
ASTM A 36/A 36M	-	Standard Specification for Carbon Structural Steel
ASTM A 53	-	Standard Specification for Pipe, Steel, Black & Hot Dipped, Zinc-Coated, Welded, and Seamless
ASTM A 105	-	Standard Specification for Carbon Steel Forgings for Piping Applications
ASTM A 183	-	Standard Specification for Carbon Steel Track Bolts and Nuts
ASTM A 216	-	Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding for High Temperature Service
ASTM A 307	-	Standard Specification for Carbon Steel Bolts and Studs
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 A 1011/A 1011M	-	Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
ASTM A 1018/A 1018M	-	Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Carbon, Commercial, Drawing, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
ASTM D 2000	-	Standard Classification System for Rubber Products

Cement-Mortar Lined and Coated
Steel Pipe and Specials

ANSI B1.1	-	Unified Inch Screw Threads
ANSI B1.2	-	Gages and Gaging for Unified Inch Screw Threads
ANSI B1.20.1	-	Pipe Threads, General Purpose (Inch)

1.03 RELATED WORK SPECIFIED ELSEWHERE

WAS Standard Drawings

WAS Standard Specifications 01000, 02223, 03000, 09910, 13110, 15000, 15041, 15044, 15045, 15074, 15100, 15102, 15108, 15112, and 15300.

1.04 SERVICE APPLICATION

Cement-mortar lined and coated steel pipe and specials shall be used only for specific purposes as shown on the Approved Plans. Generally, cement-mortar lined and coated steel pipe shall be used for transmission mains of 16" or larger.

1.05 SPECIALS

A special is defined as any piece of pipe other than a normal full length of straight pipe. This includes, but is not limited to, elbows, short pieces, reducers, tees, crosses, spools, sections with outlets, beveled sections and manholes.

1.06 DESIGN REQUIREMENTS

- A. All steel used for pipe or specials shall have a 248 MPa (36,000psi) minimum yield point unless otherwise directed by the District Engineer. See material information concerning steel designation below.
- B. Design stress in steel cylinders shall not exceed 50% of the specified minimum yield strength of the steel used. The internal operating pressure used for design shall be a minimum of 1.03 Pa (150psi) or as called for on the Approved Plans, whichever is greater. If no specific surge analysis has been performed, the internal operating pressure used in circumferential stress calculations shall include at least a 10% increase for surge conditions. No allowance shall be made for the tensile strength of the cement mortar lining and coating.
- C. Specials shall be designed per AWWA M11 and as a minimum shall conform to the pressure rating, grade of steel and cylinder thickness of the adjoining standard pipe sections. Fitting dimensions shall conform to AWWA C208. Reinforcing collars, wrappers, crotch plates, and anchor rings shall be designed and fabricated per AWWA M11.
 - 1. Outlets may be built into the wall of the pipe or may be fabricated as steel plate specials. Outlets of size 50mm (2") and smaller in piping 100mm (4") and larger shall be of the threadolet type or shall be extra-heavy half couplings to fit the pipe in accordance with AWWA M11. Outlets shall be 1360kg (3,000 lb.) WOG forged steel per ASTM A105. Threads shall comply with ANSI B1.20.1. Outlets larger than 50mm (2") shall use a tee or nozzle with a flanged outlet. All outlets larger than 50mm (2") in diameter shall be provided with steel reinforcing collars, wrapper plates, or crotch plates per AWWA M11. At the option of the manufacturer, wrappers may be used in place of collars, and crotch plates may be used in place of collars or wrappers.

2. On 50mm (2") and smaller outlets where nylon insulation bushings are to be used, the outlet shall be increased in size to accept the bushing.
 3. Tees, wyes, and crosses shall be dimensioned in accordance with AWWA C208, Table 1, or as modified on the Approved Plans.
 4. Bends shall have a minimum radius of not less than 2½ times the pipe diameter unless otherwise approved by the District Engineer. The maximum deflection at mitered girth seams shall be 2½E. At the option of the Contractor, a bend may be welded to the adjacent pipe section.
 5. All specials shall be marked at both ends of the fitting with "Field Top" indicators.
- D. Minimum cylinder thickness for pipe and specials shall be 6.35mm (0.250" or ¼") or as directed by the District Engineer.

The wall thickness tolerances for steel pipe 300mm (12") diameter and larger shall be governed by the requirements of the ASTM specifications to which the plates or sheets are ordered, but in no case shall the thickness be less than 6.35mm (0.250" or ¼") or as directed by the District Engineer.

- E. Standard pipe sections shall not be less than 6m (20') nor more than 12m (40') in length, except where shorter lengths are required to fit horizontal and vertical alignment or are otherwise shown on the Approved Plans.
- F. Pipe ends shall be as follows:
1. Bell and Spigot with Rubber Gasket: In accordance with AWWA C200 and AWWA M11. Bell ends that are pressed or rolled shall be limited to maximum pipe diameter of 525mm (21") nominal.
 2. Lap Welded Joints: Use expanded bell with matching spigot end.
 3. Flanges: Flanges for use in construction of Steel Pipe shall be as described below.
 - a. AWWA C207, Class D flanges (matching ANSI/ASME B16.1, Class 125 flanges for bolt hole size and drilling) shall be used for pressures up to 1.03 MPa (150 psi).
 - b. AWWA C207, Class E flanges (matching ANSI/ASME B16.1, Class 125 flanges for bolt hole size and drilling) shall be used for pressures between 1.03 MPa and 1.72 MPa (150 psi and 250 psi).
 - c. AWWA C207, Class F flanges (matching ANSI/ASME B16.1, Class 250 flanges for bolt hole size and drilling) shall be used for pressures between 1.72 MPa and 2.07 MPa (250 psi and 300 psi) or when Class 250 butterfly valves or other appurtenances using flanges corresponding to AWWA C207 Class F are required.
 - d. Flanges shall be flat-faced type only. Segmented flanges shall not be used.

4. **Butt Straps:** Use two-piece rolled steel straps with a minimum thickness of 6.35mm (1/4"), and a minimum width of 250mm (10"). Straps shall be fabricated to snugly fit over the plain pipe ends, and shall be centered over the ends of the pipe sections to be joined. Weld one standard 125mm (5"), 1361kg (3000 lb.) threaded half-coupling to the butt strap section for butt straps up to and including 500mm (20") in nominal diameter. Weld two standard 125mm (5"), 1361 kg (3000 lb.) threaded half-couplings to the butt strap section for butt straps greater than 500mm (20") in nominal diameter. Provide a threaded steel plug for each half-coupling.
5. **Grooved-End or Shouldered Couplings:** Use square-cut shouldered or grooved ends per AWWA C606. Grooved-end couplings shall be malleable iron per ASTM A 47, or ductile-iron per ASTM A 536. Gaskets shall be per ASTM D 2000. Nuts and bolts in exposed service shall conform to ASTM A 183, 758.43 MPa (110,000 psi) tensile strength.
6. **Flexible Pipe Couplings:** Use plain-end pipe with flexible pipe couplings per AWWA C200. Provide joint harnesses per AWWA M11 where indicated on the Approved Plans.

G. **Angles or Curves in Alignment:**

Minor changes of direction in the grade or alignment may be made by a deflection in the joint up to a maximum of 19mm (3/4") on one side of the joint. For greater angular deflections, pipe with ends beveled up to a maximum of 5 degrees measured from a plane perpendicular to the pipe's axis may be used. The short point on the bevel shall be so marked on the pipe. Pipe length shorter than 6m (20') may be used on curves. Where curves that have a shorter radius than can be accommodated by beveled pipe are required, or where indicated on the Approved Plans, special short-radius bends shall be provided.

H. **Mortar Coating and Lining:**

Use coatings and linings conforming to AWWA C205, except as noted below. All exterior metal surfaces intended for direct buried service shall be coated.

1. Mortar coating thickness shall be 31.8mm (1 1/4").
2. Mortar lining thickness shall be as follows:

- a. Pipelines 400mm (16") and smaller:

<u>Lining Thickness</u>	<u>Tolerance</u>
7.94mm (5/16")	-1.59mm, +3.18mm (-1/16", +1/8")

- b. Pipelines 450mm (18") through 900mm (36"):

<u>Lining Thickness</u>	<u>Tolerance</u>
19.05mm (3/4")	-1.59mm, + 3.18mm (-1/16", +1/8")

- c. Pipelines larger than 900mm (36"):

<u>Lining Thickness</u>	<u>Tolerance</u>
19.05mm (3/4")	-1.59mm, + 4.77mm (-1/16", +3/16")

- I. The exterior surfaces of areas of pipes and fittings that are not mortar coated, such as flanges, grooved ends, or plain ends for butt-straps or flexible couplings, shall be sandblasted in accordance with SSPC-SP10 - Near White Blast Cleaning, and coated in accordance with Section 15000.
- J. The term "diameter of pipe" as used in these specifications or as shown on the Approved Plans shall mean the net inside diameter of the mortar lining.

1.07 QUALITY ASSURANCE

- A. Cement-mortar lined and coated steel pipe shall be inspected at the supplier's manufacturing plant by the District Engineer. Contractor shall be responsible for District Engineer's expenses, including travel, time, meals and overnight accommodations. Overnight accommodations and air travel may be required if the manufacturing plant is more than 200 miles from the District Engineer's office.
- B. In addition to the shop hydrostatic testing performed on pipe cylinders required per AWWA C200, all welds of specials and attachments (i.e. joint rings and nozzles) shall be tested by a dye penetrant process. Certification of such testing shall be submitted to the District.
- C. Field welders shall be certified under Section IX, Part A of the ASME Boiler and Pressure Vessel Code or in accordance with AWWA C206, Section 4.4. Welders shall present a copy of their certification to the District prior to performing any field welding. Certifications shall be dated within three (3) years of the job to be performed.
- D. Plainly mark each length of straight pipe and each special at the bell end to identify the proper location of the pipe item by reference to the layout schedule.
- E. The top of all pipe and specials shall be clearly identified by marking the top with "T.O.P." for easy identification in the field.
- F. Closed-Circuit Television Inspection: A closed-circuit television (CCTV) inspection shall be performed by Contractor on all steel pipe 36" and smaller in accordance with Section 15045.

1.08 DELIVERY, STORAGE, AND HANDLING

Delivery, storage, and handling of the pipe and specials shall be as follows:

- A. Pipe and fittings shall be carefully handled and shall be protected against damage to linings and coatings due to impact shocks. Pipe shall not be placed directly on rough ground but shall be supported in a manner which will protect the pipe against injury whenever stored at the site or elsewhere. Pipe shall be handled and stored per these requirements and in accordance with the Manufacturer's recommendations.
- B. Temporary internal bracing shall be installed in all pipe 400mm (16") and larger prior to shipment to the job site. Temporary internal bracing shall be 100mm x 100mm (4" x 4") wooden struts installed in both the horizontal and vertical directions. Each set of struts shall be nailed together as a unit. Wooden wedges may be used to maintain the proper tight fit of the internal bracing. The bracing shall be located 300mm (12") in from each end of the pipe section for all pipe, and additionally at the mid-point for piping 600mm (24") and larger. Maintain internal bracing as specified under Pipe Installation.

- C. Transport pipe to the job site on padded bunks with nylon tie-down straps or padded bonding to protect the pipe.
- D. Pipes and specials shall only be handled with appropriate spreader bars and wide nylon slings. Chains or wire rope slings shall not be used. Under no circumstances shall pipe or specials be pushed or dragged along the ground. All pipe sections over 6m (20') in length shall be lifted at the quarter points from each end.
- E. Store pipe on earth berms or padded timber cradles adjacent to the trench in the numerical order of installation. Place the supports at about the one-quarter point from the pipe ends.
- F. Maintain plastic end caps on all pipe and specials in good condition until the pipe is ready to be installed in the trench. Periodically open the plastic end caps and spray potable water inside the pipe to moisten the mortar lining as directed by the District Engineer.

1.09 SUBMITTALS

The following items shall be submitted to the District for review and approval prior to fabrication of steel pipe and specials:

- A. An affidavit of compliance with AWWA C200 and C205.
- B. Tabulated layout schedule including:
 - 1. Order of installation and closures.
 - 2. Pipe station and bottom of pipe (BOP) elevation at each change of grade and alignment.
 - 3. Elements of curves and bends, both in horizontal and vertical alignment.
 - 4. Pipe internal diameter, wall thickness, and internal design pressure.
 - 5. Locations of bulkheads for field hydrostatic testing. (Testing against valves shall not be permitted).
 - 6. Locations of closures, including cut-to-fit allowances, for length adjustment and for construction convenience.
 - 7. Locations of valves, flanges, appurtenances and other mechanical equipment.
- C. Details of all specials, and of the lining and coating.
- D. Calculations supporting the sizing of reinforcing collar plates, wrapper plates or crotch plates.
- E. Calculations supporting selected wall thickness of pipe and specials.
- F. Calculations supporting welded joint design and joint welding details.
- G. Current shop welder and field welder certifications.
- H. Mill test reports on each heat from which steel is rolled, at the discretion of the District Engineer.

- I. Certification of dye penetrant shop-weld testing.
- J. Cathodic Protection design and installation details.

1.10 RECYCLED WATER IDENTIFICATION

Cement-mortar lined and coated steel pipe and specials for recycled water shall be identified with purple colored coating, purple polyethylene sleeves, identification labels, or signs in accordance with Section 15151.

1.11 WAX TAPE

Wax tape shall be installed in accordance with Section 13100 as shown on the Approved Plans or as directed by the District Engineer.

1.12 TRACER WIRE

Tracer wire shall be installed on all cement-mortar lined and coated steel potable and recycled water mains in accordance with Section 15000.

1.13 WARNING/IDENTIFICATION TAPE

Warning/Identification Tape shall be installed on all cement-mortar lined and coated steel potable and recycled water mains in accordance with Section 15000.

PART 2 MATERIALS

2.01 STEEL PIPE AND SPECIALS

Steel pipe and specials shall conform to the requirements of the AWWA C200 and C205, and AWWA M11, except as modified herein.

Steel for fabricated cylinders shall conform to ASTM A 36/A 36M, ASTM A 1011/A 1011M, Grade 36, or ASTM A1018/A 1018M, Grade 36. Other steel grades may be used only upon approval of the District Engineer.

2.02 MORTAR LINING AND COATING

- A. Cement used in mortar lining and coating shall be Portland Cement per ASTM C 150, Type V for coating and Type II or Type V for lining.
- B. Cement-mortar coating shall be reinforced in accordance with AWWA C205.

- C. Cement mortar grout for field joints shall consist of a mixture of 1½ to 2 parts sand to 1 part Type II or Type V Portland Cement with enough clean, potable water to permit packing and troweling without crumbling. The sand shall be washed, well-graded sand such that all will pass a No. 8 sieve. The quantity of water to be used in the preparation of grout shall be the minimum required to produce a mixture sufficiently workable for the purpose intended. Grout shall attain a minimum compressive strength of 12.4 MPa (1,800 psi) in 28 days.
- D. In certain circumstances, rapid-setting mortar may be required. Acceleration admixtures may be used in the mix as permitted by the District Engineer. Calcium chloride shall not be used in the mix.

2.03 PAINTING AND COATING

- A. Paint and coating products for exterior surfaces of all pipe and appurtenances not otherwise mortar-coated shall be in accordance with Section 09910 and the Approved Materials List.
- B. Paint and coating products for areas in contact with potable water such plain ends of pipe, grooved and shouldered ends of pipe and exposed inside surfaces of threaded outlets and blind flanges shall be in accordance with Section 15000 and selected from the Approved Materials List.

2.04 BOLTS AND NUTS FOR FLANGES

Bolts and nuts shall be in accordance with Section 15000 and the Approved Materials List.

2.05 GASKETS

- A. Rubber-ring gaskets shall comply with AWWA C200 according to the applicable joint type and pressure rating of the piping system.
- B. Flange gaskets shall comply with AWWA C207. Flange gaskets shall be 3.18mm (1/8") thick aramid fibers bound with nitrile for all sizes of pipe. Gaskets shall be full-face type with pre-punched holes.
- C. In the event of encountering organic solvents or petroleum products during the course of the work, alternate gasket materials or joint treatment will be required as directed by the District Engineer.

2.06 JOINT BONDING AND CATHODIC PROTECTION

Joint bonding, flange insulation kits, internal epoxy linings, and cathodic protection materials shall be provided as indicated on the Approved Plans and in accordance with Section 13110 and the Approved Materials List.

2.07 IMPORTED GRANULAR MATERIAL FOR PIPE AND TRENCH ZONES

The imported granular material for use in pipe and trench zones shall be in accordance with Section 02223.

2.08 CONCRETE

Concrete used for thrust and anchor blocks shall be in accordance with Section 03000.

2.09 WAX TAPE

Wax tape materials shall be in accordance with Section 13110 and the Approved Materials List.

2.10 CLOSED-CIRCUIT TELEVISION INSPECTIONS

The Contractor shall furnish all equipment and materials required for CCTV inspections in accordance with Section 15045.

2.11 TRACER WIRE

Tracer wire materials shall be in accordance with Section 15000 and the Approved Materials List.

2.12 WARNING/IDENTIFICATION TAPE

Warning/Identification Tape materials shall be in accordance with Section 15000 and 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, the ends of the pipe shall be closed with tight-fitting, vermin-proof and child-proof caps or plugs. 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 at all times.

3.02 TRENCH EXCAVATION, BACKFILL AND COMPACTION

Trenching, backfilling and compaction shall be performed in accordance with Section 02223.

3.03 DEWATERING

Dewatering of trench excavations shall be performed in accordance with Section 02223. If flooding of the trench does occur, the Contractor shall immediately dewater and restore the trench. Damaged or altered pipelines, appurtenances, or trench materials shall be repaired or replaced as directed by the District Engineer.

3.04 PIPE INSTALLATION

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. Generally, the aforementioned safety provisions apply to pipe 600mm (24") and larger. Note that for pipe less than 600mm (24") diameter, more stringent safety procedures apply.

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.

Pipe installation shall be as shown on the Approved Plans and Shop Drawings in accordance with the following:

- A. No pipe shall be installed where the linings or coatings show cracks that may be harmful as determined by the District Engineer. Such damaged linings and coatings shall be repaired or new, undamaged pipe sections shall be provided.
- B. Pipe damaged prior to Substantial Completion shall be repaired or replaced by the Contractor.
- C. The Contractor shall inspect each pipe and fitting to insure that there are no damaged portions of the pipe. The Contractor shall remove or smooth out any burrs, gouges, weld splatter, or other small defects prior to laying the pipe.
- D. Before placement of pipe in the trench, each pipe or fitting shall be thoroughly cleaned of any foreign substance which may have collected thereon and shall be kept clean at all times thereafter. For this purpose, the openings of all pipes and fittings in the trench shall be closed during any interruption to the work as noted above.
- E. Pipe shall be laid directly on the bedding material. No blocking will be permitted, and the bedding shall be such that it forms a continuous, solid bearing for the full length of the pipe. Excavations shall be made as needed to facilitate removal of handling devices after the pipe is laid. Bell holes shall be formed at the ends of the pipe to prevent point loading at the bells or couplings and to permit visual inspection of the joint. Excavation shall be made as needed outside the normal trench section at field joints to permit adequate access to the joints for field connection operations and for application of coatings on field joints.
- F. Installation Tolerances: Each section of pipe shall be laid in the order and position shown on the approved layout schedule to the proper lines and grades in accordance with the following:
 1. Each section of pipe having a nominal diameter less than 1200mm (48") shall be laid not to vary more than 50mm (2") horizontally or 25mm (1") vertically from the alignment and elevations shown on the Approved Plans.
 2. Each section of pipe having nominal diameter 1200mm (48") and larger shall be laid not to vary more than five percent (5%) of the pipe diameter horizontally or two and one half percent (2.5%) of the pipe diameter vertically.

3. In addition to the horizontal and vertical tolerances above, lay the pipe so that no high or low points occur along the pipeline other than those shown on the approved layout schedule.
- G. Where necessary to raise or lower the pipe due to unforeseen obstructions or other causes, the District Engineer may change the alignment and/or the grades. Such change shall be made by the deflection of joints, by the use of bevel adapters, or by the use of additional fittings. However, in no case shall the deflection in the joint exceed seventy five percent (75%) of the maximum deflection recommended by the pipe manufacturer. No joint shall be deflected any amount that will be detrimental to the strength and water tightness of the finished joint. In all cases the joint opening, before finishing with the protective mortar inside the pipe, shall be the controlling factor.
- H. Pipes shall be laid uphill on grades exceeding 10 percent. Pipe that is laid on a downhill grade shall be blocked and held in place until the following pipe section has been installed to provide sufficient support to prevent movement.
- I. Temporary internal pipe bracing shall be left in place in pipe sizes larger than 600mm (24") until pipe zone compaction has been completed. Bracing in pipe smaller than 600mm (24") may be removed immediately after the pipe has been laid into the trench. The Contractor shall employ a laboratory to monitor pipe deflection by measuring pipe inside diameter before bracing is removed and 24 hours after struts are removed. Pipe deflection shall not exceed 2 percent in 24 hours after the bracing has been removed. After the backfill has been placed, the struts shall be removed.
- J. Cold Weather Protection: No pipe shall be installed upon a foundation onto which frost has penetrated or at any time that there is a danger of the formation of ice or penetration of frost at the bottom of the excavation. No pipe shall be laid unless it can be established that the trench will be backfilled prior to formation of ice and frost.
- K. Pipe and Specials Protection: The openings of all pipe and specials where the pipe and specials have been mortar-lined in the shop shall be protected with suitable bulkheads to maintain a moist atmosphere and to prevent unauthorized access by persons, animals, water, or any undesirable substance. The bulkheads shall be designed to prevent drying out of the interior of the pipe. The Contractor shall introduce water into the pipe to keep the mortar moist where moisture has been lost due to damaged bulkheads.

3.05 FIELD WELDED JOINTS

- A. Welded joints shall be completed in the trench per AWWA C206.
- B. Both the bell and spigot ends shall be cleaned of foreign matter prior to welding.
- C. For pipe diameters less than 600mm (24") the exterior of the joint shall be welded. For pipe diameter 600mm (24") and larger, the joint shall be welded in accordance with the approved submittal. All welded joints shall remain exposed until inspection has been performed.
- D. Welding electrodes shall be as recommended by the pipe manufacturer. Typically, electrodes shall be E6010 for root passes and E7018 for additional passes. Do not deposit more than 3.2mm (1/8") of throat thickness per pass.
- E. Weld material shall be deposited in successive layers. Complete and clean each pass around the entire circumference of the pipe before commencing the next pass.

Cement-Mortar Lined and Coated
Steel Pipe and Specials

F. The minimum number of passes in the completed weld shall be as follows:

Steel Cylinder Thickness		Fillet Weld Minimum
mm	(inches)	Number of Passes
6.35 or less	(0.2500 or 1/4")	2
Greater than 6.35	(0.2500 or 1/4")	3

G. To minimize longitudinal stresses due to temperature variations, it is necessary to leave unwelded one joint per each 120m (400') of pipeline. This joint shall be left unwelded until all the joints on both sides of it are welded, and it shall be welded at the coolest time of the working day. The District Engineer shall decide if and when this procedure is warranted.

H. Tack-welding the joint may be permitted to hold the pipe in place. If the joint is to be circumferentially welded, sufficient time shall elapse to allow for an initial set of interior joint lining prior to proceeding with joint welding. Rapid-setting mortar may be used in accordance with this Section. In some cases, the District Engineer may require hand holes.

I. Field welders shall be certified in accordance with ASME Section IX (pipe welders) or AWS D1.1 (plate welders). Welders shall present a copy of their certification to the District Engineer prior to performing any field welding.

J. Prior to butt-strap welding, the pipe and pipe joint shall be properly positioned in the trench using line-up dams so that, in the finished joint, the abutting pipe sections shall not be misaligned by more than 1.59mm (1/16").

K. The pipe ends shall be cut straight on joints where butt straps are used for realignment, adjustment, or deflection, and fillet welds shall be made as indicated.

L. Inspection of Field Welded Joints:

1. The District shall arrange for the welds to be inspected. Inspection of welds shall take place as soon as possible following the completion of the welds.
2. The Contractor shall coordinate and supply ventilation, lighting, and other equipment deemed necessary for inspection. The Contractor shall be responsible for providing safe entry into and out of the trench, safety of inspection personal, traffic control and other safety precautions deemed necessary for the inspections.

3.06 INTERIOR JOINT FINISH - PIPE LESS THAN 600mm (24")

Complete interior mortar joints for pipe sizes less than 600mm (24") by drawing through a tight-fitting swab or squeegee. Coat the face of the cement mortar lining at the bell with a sufficient amount of stiff cement mortar to fill the gap. Immediately after joining the pipes, draw the swab through the pipe to remove all excess mortar and expel it from the open pipe end. Do not move the pipe after the swab has been pulled past the joint. See requirements under "Field Welded Joints" for these joints requiring welding.

3.07 INTERIOR JOINT FINISH - PIPE 600mm (24") AND LARGER

- A. Complete interior mortar joints for pipe sizes 600mm (24") and larger by the trowel method. Prior to applying interior mortar at the joints all backfill in the area shall be completed. After cleaning the interior joint, pack cement mortar into each joint. Finish the surface with a steel trowel to a smooth finish and equal thickness to match the adjoining pipe mortar.
- B. Where more than a 100mm (4") joint strip of mortar is required, place galvanized welded wire mesh reinforcement in 50mm x 100mm (2" x 4") pattern of No. 13 gauge over the exposed steel. Install the mesh so that the wires on the 50mm (2") spacing direction run circumferentially around the pipe. Crimp the wires on the 100mm (4") spacing to support the mesh 9.5mm (3/8") from the metal surface. Steel-trowel finish the interior mortar to match adjoining mortar-lined pipe sections.

3.08 CLOSED-CIRCUIT TELEVISION INSPECTIONS

Closed-circuit television inspections shall be performed by the Contractor in accordance with Section 15045.

3.09 EXTERIOR JOINT FINISH

- A. The outside annular space between pipe sections shall be completely filled with grout formed by the use of polyethylene foam-lined fabric bands. The grout space shall be flushed with water prior to filling so that the surfaces of the joint to be in contact with the grout will be thoroughly moistened when the grout is poured. The joint shall be filled with grout by pouring from one side only. Grout shall be rodded with a wire or other flexible rod or vibrated so that the grout completely fills the joint recess by moving down one side of the pipe, around the bottom of the pipe and up the opposite side. Pouring and rodding the grout shall be continued to allow completion of the filling of the entire joint recess in one operation. Care shall be taken to leave no unfilled space. Grouting of the outside joint spaces shall be kept as close behind the laying of the pipe as possible except that in no case shall grouting be closer than three joints of the pipe being laid.
- B. The grout bands or heavy-duty diapers shall be polyethylene foam-lined fabric with steel strapping of sufficient strength to hold the fresh mortar, resist nodding of the mortar, and allow excess water to escape. The foam plastic shall be 100 percent closed cell, chemically inert, insoluble in water and resistant to acids, alkalis and solvents. Foam Plastic shall be Dow Chemical Company, Ethafoam 222, or equal.

The fabric backing shall be cut and sewn into 224mm (9") wide strips with slots for the steel strapping on the outer edges. The polyethylene foam shall be cut into strips 150mm (6") wide and slit to a thickness of 6.35mm (1/4") that will expose a hollow or open-cell surface on one side. The foam liner shall be attached to the fabric backing with the open or hollow cells facing towards the pipe. The foam strip shall cover the full interior circumference of the grout band with sufficient length to permit a 200mm (8") overlap of the foam at or near the top of the pipe joint. Splices to provide continuity of the material will be permitted. The polyethylene foam material shall be protected from direct sunlight.

The polyethylene foam-lined grout band shall be centered over the joint space with approximately equal widths extending over each pipe end and securely attached to the pipe with the steel straps. After filling the exterior joint space with grout, the flaps shall be closed and overlapped in a manner that fully encloses the grout with polyethylene foam. The grout band shall remain in position on the pipe joint.

- C. Following grouting, the joint shall be wrapped with two layers of polyethylene encasement in accordance with per Section 15000.

3.10 BUTT STRAP JOINTS

Butt strap closure joints shall be installed where shown on the Approved Plans in accordance with AWWA C206.

- A. Butt straps shall be field welded to the outside plain end of the pipe along both edges with a full circumferential weld. A minimum of two weld passes shall be used.
- B. The interior of the joints shall be filled with a rapid-set mortar and finished off smoothly to match the pipe interior diameter.
- C. Clean the butt strap with a wire brush and apply a cement and water wash coat prior to applying cement mortar.
- D. Galvanized wire mesh, 50mm x 100mm (2" x 4") x No. 13 gauge shall be installed to the exterior of the joint prior to applying the mortar coating.
- E. Coat the exterior of the closure assemblies with mortar to cover all steel with a minimum of 32mm (1¼").
- F. Seal weld the steel plug to the hand hole after the interior of the joint has been inspected and approved by the District Engineer.
- G. Following grouting, the joint shall then be wrapped with two layers of polyethylene encasement in accordance with Section 15000.

3.11 FLANGED CONNECTIONS

Flanged connections shall be installed where indicated on the Approved Plans.

- A. Bolt holes shall straddle the vertical centerline.
- 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. Slip-on type flanges intended for field fit-up and welding shall be welded inside and outside in accordance with AWWA C207.
- F. Coat the exterior of exposed flanges, bolts and nuts in accordance with Section 09910.

3.12 FLANGED COUPLING ADAPTERS

Flanged coupling adapters shall be installed in accordance with the manufacturer's recommendations. Bolts shall be tightened with a torque wrench in the presence of the District Engineer to the torque recommended by the manufacturer.

3.13 JOINT BONDING/CATHODIC PROTECTION INSULATION

Bonding of joints to provide continuity, flange insulation kits, internal epoxy linings, and other cathodic protection items and materials shall be installed where shown on the Approved Plans in accordance with the Standard Drawings and Section 13110.

3.14 WAX TAPE

Wax tape shall be installed as shown on the Approved Plans or as directed by the District Engineer in accordance with Section 13110 and the Standard Drawings.

3.15 CONCRETE

Where required, concrete thrust and anchor blocks shall be installed in accordance with Section 03000 and as shown on the Approved Plans. Prior to filling the pipeline with water, refer to Section 03000 for the minimum concrete curing time required.

3.16 TRACER WIRE

Tracer Wire shall be installed in accordance with Section 15000 and the Standard Drawings.

3.17 WARNING/IDENTIFICATION TAPE

Warning/Identification Tape shall be installed in accordance with Section 15000 and the Standard Drawings.

3.18 DISINFECTION AND BACTERIOLOGICAL TESTING

Disinfection, bacteriological testing, and flushing shall be performed in accordance with Section 15041.

3.19 HYDROSTATIC TESTING

Field hydrostatic testing shall be performed in accordance with Section 15044.

3.20 FIELD PAINTING AND COATING

- A. Exterior surfaces of all pipe and appurtenances not otherwise mortar-coated shall be field painted in accordance with Section 09910.

- B. Areas in contact with potable water such plain ends of pipe, grooved and shouldered ends of pipe and exposed inside surfaces of threaded outlets and blind flanges shall be coated in accordance with Section 15000.

END OF SECTION

WATER AGENCIES' STANDARDS

STANDARD SPECIFICATIONS

SECTION 15074 BLOWOFF ASSEMBLIES

PART 1 GENERAL

1.01 DESCRIPTION

This section includes materials, testing, and installation of blowoff assemblies.

1.02 RELATED WORK SPECIFIED ELSEWHERE

WAS Standard Drawings

WAS Standard Specifications 02223, 03000, 09910, 15000, 15041, 15044, 15056, 15057, 15061, 15064, and 15100

1.03 SERVICE APPLICATION

- A. Blowoff assemblies shall be installed on potable and recycled water mains.
- B. Blowoff assemblies shall be sized and located as shown on the Approved Plans. In general, blowoff assemblies will be installed at the ends and at low points of pipelines as shown below:
 - 1. 50mm (2") blowoff assemblies will be required on pipelines for temporary use, when shown on the Approved Plans, or as otherwise directed by the District Engineer.
 - 2. 100mm (4") blowoff assemblies will be required on pipeline sizes 400mm (16") and smaller.
 - 3. 150mm (6") blowoff assembly will be required on pipeline sizes 450mm (18") and larger.

1.04 RECYCLED WATER IDENTIFICATION

Blowoff assemblies for recycled water shall be identified with purple-colored coating, identification labels or signs in accordance with Section 15151.

1.05 WARNING/IDENTIFICATION TAPE

Warning/Identification tape shall be installed for blowoff assemblies in accordance with Section 15000.

PART 2 MATERIALS

2.01 GENERAL

Blowoff assemblies and appurtenant components and materials shall be selected from the Approved Materials List.

2.02 CONCRETE

Concrete used for thrust or anchor blocks shall be in accordance with Section 03000.

2.03 WARNING/IDENTIFICATION TAPE

Warning/Identification tape materials shall be in accordance with Section 15000 and the Approved Materials List.

2.04 FIELD PAINTING AND COATING

Field painting and coating materials shall be in accordance with Section 09910 and the Approved Materials List.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Blowoff assemblies shall be installed at locations shown on the Approved Plans or as directed by the District Engineer in accordance with the Standard Drawings.
- B. Blowoff assemblies shall be connected to water mains no closer than 600mm (24") to a bell, coupling, joint or fitting.
- C. Locations of blowoff assembly meter boxes or valve boxes shall be in accordance with the Standard Drawings.

3.02 CONCRETE

Concrete thrust and anchor blocks shall be installed in accordance with Section 03000 and the Standard Drawings. Refer to Section 03000 for the minimum concrete curing time required.

3.03 WARNING/IDENTIFICATION TAPE

Warning/Identification tape shall be installed in accordance with Section 15000 and the Standard Drawings.

3.04 DISINFECTION OF BLOWOFF ASSEMBLIES

Blowoff assemblies shall be disinfected in accordance with Section 15041 in conjunction with disinfecting the main to which it is connected. Blowoff assembly valves shall be operated and the assembly shall be flushed to completely disinfect all internal parts.

3.05 HYDROSTATIC TESTING

Blowoff assemblies shall be hydrostatically tested in accordance with Section 15044 in conjunction with hydrostatically testing the pipeline to which it is connected.

3.06 FIELD PAINTING AND COATING

Blowoff assembly appurtenances shall be field-painted in accordance with Section 09910.

END OF SECTION

WATER AGENCIES' STANDARDS

STANDARD SPECIFICATIONS

SECTION 15102 BUTTERFLY VALVES (BFV's)

PART 1 GENERAL

1.01 DESCRIPTION

This section includes materials, testing, and installation of manually operated butterfly valves (BFV).

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. References 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 C504	Rubber-Seated Butterfly Valves
AWWA C550	Protective Epoxy Interior Coatings for Valves and Hydrants
SSPC	Steel Structures Painting Council

1.03 RELATED WORK SPECIFIED ELSEWHERE

WAS Standard Drawings
WAS Standard Specifications 02223, 03000, 09910, 15000, 15041, 15044, 15056, 15061 and 15064

1.04 SERVICE APPLICATION

- A. Butterfly valves (BFV) shall be installed on potable and recycled water mains and appurtenances where shown on the Approved Plans and in accordance with the Standard Drawings.
- B. Butterfly valves shall be used for open/closed operations and throttling service and frequent operation after long periods of inactivity.
- C. In general butterfly valves shall be used when valves are required on pipelines 350mm (14") and larger and where the use of a motor-operated valve is required as shown on the Approved Plans. Butterfly valves smaller than 350mm (14") shall only be used as indicated on the Approved Plans or with the prior approval of the District Engineer.
- D. Valves for pipelines sized 300mm (12") and smaller generally require resilient wedge gate valves (RWGV's) in accordance with Section 15100.

1.05 SUBMITTALS

The following items shall be submitted for review and approval by the District Engineer prior to ordering or delivery of butterfly valves.

- A. An affidavit from the valve manufacturer showing the following:
 - 1. Actuators used were furnished and installed by the valve manufacturer.
 - 2. Valves have successfully passed hydrostatic testing per AWWA C504 and coatings testing by the valve manufacturer.
- B. The valve manufacturer's catalog data showing the size to be used, valve dimensions, pressure rating and materials of construction.
- C. Actuator manufacturer's catalog data and detail construction sheets showing the dimensions, materials, number of turns, and required torque input of the actuator to be used.
- D. Manufacturer's catalog data and proof of NSF certification on the lining materials to be used.

1.06 SIZING OF VALVES

Valves shall be the same size as the line in which they are installed unless otherwise shown on the Approved Plans.

1.07 VALVE ENDS

Valve ends shall be flanged ductile-iron unless otherwise called for on the Approved Plans or as directed by the District Engineer.

Ductile-iron flanges shall generally be in accordance with AWWA C115, rated at a working pressure of 1,724 KPa (250 psi). When Class 250 butterfly valves are shown on the Approved Plans or are otherwise required, ductile-iron flanges shall be compatible with AWWA C207, Class "F".

Maximum working pressure of the flange shall as specified in AWWA or ASME/ANSI. Flanges shall be integrally cast per AWWA C110.

1.08 VALVE TESTING

Butterfly valves shall be hydrostatically tested and coatings shall be holiday detected prior to shipment to the field per testing procedures shown in Appendix A. Valves delivered to the site prior to successful hydrostatic testing and holiday detection will be subject to rejection.

1.09 DELIVERY, STORAGE AND HANDLING

Valves shall be delivered and stored in accordance with AWWA C504 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. Valves shall not be stored in contact with bare ground. Valves shall not be stacked.

1.10 RECYCLED WATER IDENTIFICATION

Butterfly valves for recycled water shall be identified with purple-colored coating, identification labels or signs in accordance with Section 15151.

1.11 POLYETHYLENE WRAP

Polyethylene wrap shall be used for buried installation of butterfly valves in accordance with Section 15000.

PART 2 MATERIALS

2.01 BUTTERFLY VALVES (BFV)

- A. Butterfly valves and appurtenant components and materials shall be selected from the Approved Materials List.
- B. Butterfly valves shall be short body, leak-tight closing, and rubber-seated in accordance with AWWA C504 except as modified herein.
- C. Butterfly valve bodies shall be ductile-iron as defined within AWWA C504.
- D. Except as modified below, BFV's shall be Class 150B in accordance with AWWA C504, rated for a flow velocity of 4.9m/s (16ft/s).
- E. Where the static pressure of the pipeline in which the BFV is to be installed exceeds 1.03 Pa (150psi), a Class 250B butterfly valve in general conformance with AWWA C504 shall be required. Class 250B butterfly valves shall be submitted to the Engineer for approval prior to ordering or delivery.
- F. Butterfly valves shall open by turning left (counterclockwise). Valve disc shall rotate ninety degrees (90°) from the full open position to the tight shut position.
- G. Butterfly valve interior and exterior surfaces shall be coated as described below.

2.02 MANUAL VALVE ACTUATORS

- A. General:
 - 1. All valve actuators shall be watertight, designed for buried or submerged uses. Actuators shall be fully gasketed, sealed, and factory-packed with grease.
 - 2. As directed by the District Engineer, actuators for valves located above ground or in vaults and structures may have hand wheels or chain wheels. Minimum hand wheel diameter shall be 300mm (12"). The actuator shall be equipped with a dial indicator, which shows the position of the valve disc. The District Engineer may require the use of a 50mm (2") square operating nut in some cases.
 - 3. Actuators for valves shall be provided with a 50mm (2") square operating nut when buried or when indicated on the Approved Plans.

4. Actuators shall have travel stops, which can be adjusted in the field without having to remove the actuator from the valve.
5. Actuators shall be sized for opening and closing the valve at the valve's full rated working pressure and at a flow velocity of 4.9m/s (16 ft/s).
6. Actuators shall accept a minimum of 407Nm (300 foot-pounds) of input torque at the full open and full closed positions without damage to the actuator or the valve.
7. Actuators equipped with 50mm (2") operator nuts shall require a maximum input torque of 203Nm (150 foot-pounds) to operate the valve. A maximum input torque of 108Nm (80 foot-pounds) shall be required to operate valves with hand wheels.
8. Actuators shall be of the same manufacturer as the valve where possible or as directed by the District Engineer.
9. Actuators shall be installed, adjusted, tested and certified by the valve manufacture prior to shipping.
10. Actuators shall require a maximum of one hundred (100) input turns for the complete ninety-degree (90°) movement of the disc.
11. Actuators shall receive an epoxy coating on the exterior surface as described below.

B. Traveling Nut Actuators:

1. Actuators for butterfly valves sizes 350mm (14") through 600mm (24") may be the manual traveling nut type. Traveling nut actuators shall not be used on valves requiring motor driven actuators or where the District has specified a worm gear type actuator.
2. Actuators shall be capable of producing the below listed output torque at the closed position:

<u>Valve Size in mm (inches)</u>	<u>Output Torque Nm (foot-pounds)</u>
350 (14")	2779 (2050)
400 (16")	2779 (2050)
450 (18")	3729 (2750)
500 (20")	3729 (2750)
600 (24")	6372 (4700)

C. Worm Gear Type Actuators:

1. Actuators for butterfly valves 750mm (30") or larger shall be the worm gear type. In addition, worm gear type actuators shall be used on butterfly valves requiring motor driven actuators or where the District has specified a worm gear actuator.
2. Worm gear actuators shall be totally enclosed and self-locking.

2.03 EPOXY LINING AND COATING

Epoxy linings and coatings for valves and actuators shall be provided in accordance with AWWA C210, C213 and C550, with the following modifications:

- A. Epoxy lining and coating of valve surfaces shall be performed by the manufacturer in a facility with qualified personnel, where the environment can be controlled. Epoxy lining and coating of valves in the field is prohibited.
- B. Repairs made to shop-applied coatings shall be performed in a facility with qualified personnel, where the environment can be controlled. The facility shall be one that is approved by the valve manufacturer.
- C. Surface preparation shall be as detailed in SSPC-SP5 White Metal Blast Cleaning.
- D. Liquid epoxy lining and coating materials shall be listed in the NSF Listing for Drinking Water Additives, Standard 61, certified for use in contact with potable water.
- E. The minimum dry film thickness for epoxy linings shall be 0.203mm (0.008" or 8 mils). Liquid epoxy lining shall be applied in two (2) coats in accordance with AWWA C210 and application shall conform to the coating manufacturer's recommendations.

2.04 GATE WELLS AND EXTENSION STEMS

Gate wells and extension stems for buried valves shall be in accordance with Section 15000 and the Approved Materials List.

2.05 CONCRETE

Concrete used for anchor, thrust, or support blocks shall be in accordance with Section 03000.

2.06 POLYETHYLENE WRAP

Polyethylene wrap shall be in accordance with Section 15000 and the Approved Materials List.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install valves with the bolt holes straddling the vertical and horizontal centerlines of pipe, with the operating nut in the vertical position, unless otherwise noted on the Approved Plans.
- B. Valves shall be installed per the manufacturer's recommendation in accordance with the applicable specification for the piping material and joint type being used for the valve and the water main.
- C. Joints shall be cleaned and installed in accordance with Section 15056.

3.02 FLANGE INSULATING KITS

Flange insulating kits shall be installed only where shown on the Approved Plans in accordance with Section 13110.

3.03 WAX TAPE COATINGS

Wax tape coatings shall be installed only where shown on the Approved Plans or as directed by the District Engineer in accordance with Section 13110.

3.04 POLYETHYLENE WRAP

Installation of polyethylene wrap for buried valves shall be performed in accordance with Section 15000.

3.05 CONCRETE

Concrete thrust, anchor, and support blocks shall be installed as called for in Section 03000 in accordance with the Standard Drawings. The concrete shall be placed so that valves and valve operators will be accessible for repairs or replacement. Prior to filling the pipeline with water, refer to Section 03000 for minimum concrete curing time required.

3.06 GATE WELLS AND EXTENSION STEMS

Gate wells and extension stems for buried valves shall be installed in accordance with Section 15000 and the Standard Drawings.

3.07 DISINFECTION OF THE VALVES

Disinfection and flushing shall be performed in accordance with Section 15041, as part of the process of disinfecting the main pipeline. The valves shall be operated during the disinfection period to completely disinfect all internal parts.

3.08 HYDROSTATIC TESTING

Valves shall be hydrostatically tested in conjunction with the pipeline in which it is connected in accordance with Section 15044 and Appendix "A".

3.09 FIELD PAINTING AND COATING

The exterior of valves installed above ground or exposed in vaults or enclosures shall be field painted in accordance with Section 09910.

END OF SECTION

WATER AGENCIES' STANDARDS

STANDARD SPECIFICATIONS

SECTION 15108 AIR RELEASE VALVE, AIR AND VACUUM VALVE, COMBINATION AIR VALVE AND MANUAL AIR VALVE ASSEMBLIES

PART 1 GENERAL

1.01 DESCRIPTION

This section includes the materials and installation instructions for above ground air release valves, air and vacuum valves, and combination air valve assemblies and for below ground manual air valves.

The term "air valve" is used generically in this specification to refer to requirements common to all of the specified air release valves, air and vacuum valves, and combination air valves. Otherwise, the various types of air valves are addressed by the individual designations commonly used in AWWA and industry standards.

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 C512 - Air-Release, Air/Vacuum, and Combination Air Valves for Waterworks Service
- AWWA C550 - Protective Interior Coatings for Valves and Hydrants

1.03 RELATED WORK SPECIFIED ELSEWHERE

WAS Standard Drawings
WAS Standard Specifications 02223, 03000, 09910, 15000, 15041, 15044, 15056, 15057, 15061, 15064, 15100, 16640

1.04 SERVICE APPLICATION

- A. Combination air valves are generally installed on all potable and recycled water mains where shown on the Approved Plans and in accordance with the Standard Drawings.
- B. Unless otherwise directed by the District Engineer, combination air valves will be required as indicated below:
 - 1. 50mm (2") combination air valve assemblies shall be installed on pipeline sizes 150mm (6") through 350mm (14").
 - 2. 100mm (4") combination air valve assemblies shall be installed on pipeline sizes 400mm (16") and 500mm (20").

Air Release Valve, Air and Vacuum Valve, Combination
Air Valve and Manual Air Valve Assemblies

3. 150mm (6") combination air valve assemblies shall be installed on pipeline sizes 600mm (24") through 900mm (36").
- C. Air release valves, air and vacuum valves, and manual air valves shall be installed in accordance with the Approved Plans or as directed by the District Engineer.

1.05 DELIVERY, STORAGE, AND HANDLING

Valves shall be delivered and stored in accordance with 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. Valves shall not be stored in contact with bare ground. Valves shall not be stacked.

1.06 RECYCLED WATER IDENTIFICATION

Air valve assemblies and enclosures used for recycled water shall be identified with purple-colored coating, identification labels or signs in accordance with Section 15151.

1.07 TRACER WIRE

Tracer wire shall be installed for air valve assemblies in accordance with Section 15000 and the Standard Drawings.

1.08 WARNING/IDENTIFICATION TAPE

Warning/Identification tape shall be installed for air valve assemblies in accordance with Section 15000.

PART 2 MATERIALS

2.01 COMBINATION AIR VALVES

- A. Combination air valves and appurtenant components and materials suitable for the system pressure shall be selected from the Approved Materials List.
- B. Combination air valves shall comply with AWWA C512 except as modified herein.
- C. 50mm (2") combination air valves shall be the single-body type incorporating stainless steel internal components and suction screen. National Pipe Threaded (NPT) inlet and outlet configurations.
- D. 100mm (4") and 150mm (6") combination air valves shall be the single-body type incorporating stainless steel internal components, protective hood, suction screen and flanged inlet.
- E. Internal protective epoxy coatings shall be provided in accordance with AWWA C550.

2.02 AIR RELEASE VALVES AND AIR AND VACUUM VALVES

- A. Air release valves and air and vacuum valves shall be provided only as specifically shown on the Approved Plans. Air release valves, air and vacuum valves and appurtenant components and materials suitable for the system pressure, shall be selected from the Approved Materials List.
- B. Air release valves and air and vacuum valves shall comply with AWWA C512 except as modified herein.
- C. 50mm (2") air release valves and air and vacuum valves shall be the single-body type incorporating stainless steel internal components and suction screen. National Pipe Threaded (NPT) inlet and outlet configurations.
- D. 100mm (4") and 150mm (6") air release valves and air and vacuum valves shall be the single-body style. Valves shall incorporate stainless steel internal components, suction screen, protective hood and flanged inlet.
- E. Epoxy linings and coatings for valves shall be provided in accordance with AWWA C550.
 - 1. Liquid epoxy lining and coating materials shall be listed in the NSF Listing for Drinking Water Additives, Standard 61, certified for use in contact with potable water.
 - 2. The minimum dry film thickness for epoxy linings shall be 0.203mm (0.008" or 8 mils). Liquid epoxy lining shall be applied in two (2) coats in accordance with AWWA C210.

2.03 MANUAL AIR VALVES

Manual air valves shall be provided only as specifically shown on the Approved Plans. Materials shall be in accordance with the Standard Drawings and selected from the Approved Materials List.

2.04 ENCLOSURES

Air Valve Enclosures shall be selected from the Approved Materials List.

2.05 CONCRETE

Concrete used for anchor or thrust blocks and equipment pads shall be in accordance with Section 03000.

2.06 BREAK-AWAY BOLTS

Combination air valves, air release valves and air and vacuum valves sized 100mm (4") and larger shall be installed with break-away bolts in accordance with the Standard Drawings and selected from the Approved Materials List.

2.07 TRACER WIRE

Tracer wire materials shall be in accordance with Section 15000 and selected from the Approved Materials List.

2.08 WARNING/IDENTIFICATION TAPE

Warning/Identification Tape shall be in accordance with Section 15000 and selected from the Approved Materials List.

2.09 FIELD PAINTING AND COATING

Field painting and coating materials shall be in accordance with Section 09910 and 09915 and selected from the Approved Materials List.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Air valve assemblies shall be provided as shown on the Approved Plans. Additional air valve assemblies may be required in areas of potential air entrapment, at the discretion of the District Engineer.
- B. Air valve assemblies shall be installed relative to street improvements in accordance with the Standard Drawings.
- C. Connections for the air valve assemblies shall be made within a section of the main line no closer than 600mm (24") to a bell, coupling, joint or fitting.

3.02 CONCRETE

Concrete thrust or anchor blocks and equipment pads shall be installed in accordance with Section 03000 and the Standard Drawings. Refer to Section 03000 for the minimum concrete curing time required.

3.03 TRACER WIRE

Tracer Wire shall be installed in accordance with Section 15000 and the Standard Drawings.

3.04 WARNING/IDENTIFICATION TAPE

Warning/Identification tape shall be installed in accordance with Section 15000 and the Standard Drawings.

3.05 DISINFECTION

Air valve assemblies shall be disinfected in accordance with Section 15041 in conjunction with disinfecting the main to which it is connected. The assembly valves shall be operated and the assembly flushed to completely disinfect all internal parts.

3.06 HYDROSTATIC TESTING

Air valve assemblies shall be hydrostatically tested in accordance with Section 15044 in conjunction with the pipeline to which they are connected.

3.07 FIELD PAINTING AND COATINGS

- A. Air valve assemblies shall be color coded, if required, in accordance with Section 09910.
- B. Field repairs to the enclosure shall not be permitted. Enclosures requiring repairs to the coating shall be returned to the supplier or coating vendor for repairs or recoating in accordance with Section 09915.

END OF SECTION

WATER AGENCIES' STANDARDS

STANDARD SPECIFICATIONS

SECTION 15112 BACKFLOW PREVENTERS

PART 1 GENERAL

1.01 DESCRIPTION

This section includes materials, installation, and testing of reduced-pressure backflow prevention devices and check valve and double check valve 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.

State of California Department of Health Services Division of Drinking Water and Environmental Management, Approved Backflow Prevention Assemblies for Service Isolation

AWWA C510 - Double Check Valve Backflow-Prevention Assembly

AWWA C511 - Reduced-Pressure Principle Backflow-Prevention Assembly

AWWA M14 - Recommended Practice for Backflow Prevention and Cross-Connection Control

AWWA Publication Cross-Connection and Backflow Prevention

1.03 RELATED WORK SPECIFIED ELSEWHERE

Agencies of Jurisdiction Rules and regulations regarding "Cross Connection Control and Backflow Prevention"

WAS Standard Drawings

WAS Standard Specifications 02223, 03000, 09910, 15000, 15041, 15044, 15056, 15057, 15061, 15064 and 15100.

1.04 SERVICE APPLICATION

- A. Reduced-pressure backflow prevention assemblies shall be provided on all commercial and industrial water services. Depending on degree of hazard, a double check valve assembly may be required in place of a reduced-pressure backflow assembly.
- B. Reduced-pressure backflow prevention assemblies shall be provided on irrigation services where served by potable water.
- C. Reduced-pressure backflow prevention assemblies shall be provided on potable water services where recycled water, well water or any other water supply is served to the same property.

- D. Double check valve assemblies shall be provided at all points of connections to District sources at construction sites.
- E. Reduced-pressure detector assemblies shall be provided on all fire services. Backflow prevention on fire services shall be as required by the Water District of jurisdiction.
- F. The District shall be the final authority as to the location, installation, and type of backflow prevention device required.

1.05 GENERAL DESIGN CONSIDERATIONS

- A. The design and construction of backflow prevention assemblies shall meet the requirements called for in this specification except that any modifications specifically shown on the Approved Plans shall take precedence over these general standards.
- B. The nominal size of the backflow prevention device shall be equal to or greater than the size of the purchased meter. For example, a 25mm (1") meter shall have a 25mm (1") or larger backflow device.
- C. The assembly shall include same size valves located on either side of the backflow prevention assemblies. Four test cocks shall be appropriately located on the assembly for testing and certification.
- D. The nominal size of reduced-pressure principle detector assemblies shall be as shown on the Approved Plans or as directed by the Fire Department of jurisdiction.
- E. Enclosures and concrete slabs shall be provided only as shown on the Approved Plans or as required by the agency of jurisdiction.

1.06 DELIVERY, STORAGE AND HANDLING

Backflow prevention assemblies 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 backflow assembly is ready to be installed. Backflow assemblies shall not be stored in contact with bare ground. Backflow assemblies shall not be stacked.

1.07 RECYCLED WATER IDENTIFICATION

Backflow prevention assemblies and enclosures, if required, for recycled water shall be identified with purple-colored coating, identification labels, or signs in accordance with Section 15151.

1.08 WARNING/IDENTIFICATION TAPE

Warning/Identification tape shall be installed for backflow prevention assemblies in accordance with Section 15000.

PART 2 MATERIALS

2.01 BACKFLOW PREVENTION ASSEMBLIES

Backflow prevention assemblies shall be among those listed on the list of "Approved Backflow Prevention Assemblies for Service Isolation" as issued by the State of California Department of Health Services, Division of Drinking Water and Environmental Management.

2.02 CONCRETE

Concrete used for slabs and anchor or thrust blocks shall be in accordance with Section 03000.

2.03 WARNING/IDENTIFICATION TAPE

Warning/Identification Tape shall be in accordance with Section 15000 and the Approved Materials List.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Installation shall comply with the latest edition of the Uniform Plumbing Code, applicable local agency and District requirements.
- B. Backflow prevention assemblies shall be installed in accordance with the Standard Drawings.
- C. Water service and fire service shut-off valves will be secured closed during installation until an approved backflow prevention device is installed and tested in compliance with this specification.
- D. When static pressure exceeds 1.03MPa (150psi), when recommended by the backflow device manufacturer, or when required by the District Engineer, a pressure-reducing valve shall be installed as shown on the Standard Drawings.

3.02 WARNING/IDENTIFICATION TAPE

Warning/Identification tape shall be installed in accordance with Section 15000 and the Standard Drawings.

3.03 CONCRETE

Concrete thrust or anchor blocks and slabs shall be installed in accordance with Section 03000 and the Standard Drawings. Refer to Section 03000 for the minimum concrete curing time required.

3.04 ENCLOSURES

Enclosures shall be installed where shown on the Approved Plans or as directed by the Agency of jurisdiction in accordance with the Standard Drawings.

3.05 DISINFECTION

Disinfection and flushing shall be performed in accordance with Section 15041, as part of the process of disinfecting the main pipeline. The backflow assemblies shall be operated during the disinfection period to completely disinfect all internal parts.

3.06 HYDROSTATIC TESTING

Backflow assemblies shall not be hydrostatically tested as part of or in conjunction with the pipeline to which they are connected.

3.07 TESTING

Backflow assemblies shall be tested and certified by a District-approved backflow tester after installation inspection by District is complete.

Required maintenance of the backflow prevention device and appurtenances and annual testing of the device shall be the owner's responsibility.

END OF SECTION