SECTION 33 10 01
DOMESTIC AND LAKE WATER SYSTEMS

PART 1 - GENERAL

1.1 RELATED WORK

A. Section 31 10 00: Site Preparation
B. Section 31 00 00: Earthwork
C. Section 31 23 00: Excavation and Fill
D. Section 13 47 13: Cathodic Protection
E. Section 32 12 00: Flexible Paving
F. Section 32 16 00: Concrete Paving, Curbs and Ramps
G. Section 32 00 01: Site Restoration and Rehabilitation

1.2 REFERENCES

A. American Water Works Association (AWWA):
C. C105 Polyethylene Encasement for Gray and Ductile Cast-Iron Piping for Water and Other Liquid.
E. C115 Flanged Ductile-Iron and Gray-Iron Pipe with Threaded Flanges.
F. C151 Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water and Other Liquids.
G. C153 Ductile Iron Compact Fittings 4" through 12" for Water and Other Liquids.
H. C219 AWWA C219 Bolted, Sleeve-Type Couplings for Plain-End Pipe.
I. C504 Rubber Seated Butterfly Valves
J. C509 Resilient-Seated Gate Valves, 3" through 12", for Water and Sewage Systems.
K. C600 Installation of Ductile-Iron Water Mains and their Appurtenances.
L. C601 Disinfecting Water Mains.
M. C605 Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings.
N. C800 Underground Service Line Valves and Fittings
O. C900 Polyvinyl Chloride (PVC) Pressure Pipe, 4" through 12", for Water.
P. C905 Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 in. Through 48 in., for Water Transmission and Distribution
Q. National Fire Protection Association
   a. NFPA 13 Sprinkler Systems
   b. NFPA 24 Installation of Private Fire Service Mains and Appurtenances
R. California Department of Transportation - Section 90 Portland cement concrete

1.3 SUBMITTALS
A. Provide manufacturers specification and literature for all materials furnished.
B. Contractor shall submit manufacturers' Certificates of Compliance for all materials furnished from suppliers not specifically listed in this specification or as shown on the contract drawings.
C. Contractor shall hire AWWA certified backflow prevention tester and submit certified test results after backflow prevention assemblies are installed before water can be used for potable consumption.

1.4 DELIVERY, STORAGE, AND HANDLING
A. Handling: Pipe, fittings, valves, and accessories shall be handled carefully at all times. Only suitable equipment and appliances shall be used for the safe loading, hauling, unloading, handling, and placing of materials. Special care shall be exercised so that the preformed resilient joints on pipe and fittings are not damaged.

PART 2 - PRODUCTS

2.1 WATER LINES 4-inch TO 36-inch DIAMETER
A. Ductile iron pipe (DIP): Pipe shall conform to AWWA C151, minimum pressure class 250. All ductile iron pipes shall be cement mortar lined in conformance with AWWA C104 and shall have a 1-mil thick exterior petroleum asphaltic coating. Pipe shall be of domestic manufacture: U.S. Pipe, American Ductile Iron pipe, or McWane Ductile. No substitutions. Ductile iron pipe shall be installed with a restrained joint system, per Section 2.6, unless waived by Stanford Water Resources and Civil Infrastructure. Buried ductile iron pipe and fittings shall be encased in polyethylene in accordance with AWWA C105.
B. Polyvinyl Chloride Pipe (PVC): Pipe shall conform to AWWA C900-07 / AWWA C905-10 Class 305, DR14, cast-iron O.D. sizes. Pipe shall be of domestic manufacture: JM Eagle (Eagle Loc), or Diamond Plastics Corporation (Diamond Lok); no substitutions. Pipe shall be furnished with integral bells. Spigot end pipe with separate double hub couplings is not acceptable. PVC pipe shall have an integrated pipe joint restraint system, per Section 2.6, unless waived by Stanford Water Resources and Civil Infrastructure.
2.2 WATER LINES 2-INCH AND SMALLER DIAMETER

A. Domestic Water Service: Pipe shall be annealed (soft) Type "K" copper (Cu). No hard copper tubing is permitted.

B. Irrigation Lines: Pipe shall be polyvinyl chloride Schedule 40, or Class 315, whichever has the highest pressure rating for the size required. Pipe shall be National Sanitation Foundation approved.

2.3 COUPLINGS AND SLEEVES

General: All couplings and sleeves for plain end pipe, and accessories shall be of domestic manufacture; U.S. Pipe, Tyler/Union Foundry, Smith-Blair, Hymax; no substitutions.

A. FOR DIP AND PVC PIPE: - 4-inch thru 12-inch diameter:
   1. Solid sleeves shall be mechanical joint type conforming to AWWA C153 as manufactured by Tyler/Union Foundry, or US Pipe. No substitutions.
   2. Couplings: Quantum Couplings as manufactured by Smith-Blair, Inc., and couplings as manufactured by Hymax. No substitutions.
   3. Unless otherwise noted, flanges on all DIP spools shall conform to AWWA C115.

B. FOR DIP AND PVC PIPE: 14-inch diameter and larger:
   1. Solid sleeves shall be mechanical joint type conforming to AWWA C153 as manufactured by Tyler/Union Foundry, or US Pipe. No substitutions.

C. PVC PIPE: 2-INCH AND SMALLER:
   1. PVC pipe 2-inch in diameter and smaller shall have Schedule 40, solvent-weld PVC socket couplings.
   2. For quick coupling valve installation on irrigation lines, refer to FDG Drawing IR-19.

D. COPPER TUBING:
   1. Couplings and pipe thread adaptors for copper tubing shall be Mueller 110 Compression Connection, no substitutions. Soldered joints shall not be permitted.

2.4 ASSEMBLY BOLTS AND NUTS

A. Bolts and nuts for above ground and buried flanges shall be standard hex-head, Type 316 stainless steel.

B. Bolts and nuts for mechanical joints shall be high-strength, low-alloy corrosion resistant steel conforming to ASTM A 325 (type 3).
C. All buried fasteners, bolts, and hardware shall be hand-coated with Metal Guard No. 301 Corrosion Protection Grease, by Northtown Pipe Protection Products or Christy’s, no exceptions.

2.5 FITTINGS

A. Fittings for pipe sizes 4-inches thru 36-inches shall be mechanical joint, AWWA Cl53, 350 psi working pressure-rated, ductile-iron for use with the type of pipe specified. Fittings shall be cement-mortar lined per AWWA C104 and shall have a 1-mil thick exterior petroleum asphaltic coating. T-bolts shall be AWWA C111, high strength, low alloy steel. Fittings and all accessories shall be of domestic manufacture; U.S. Pipe TrimTyte, Union Foundry, Tyler; no substitutions.

B. Fittings used at intersections of water mains where valves are required shall be cement-lined, flanged fittings. Valves at these locations shall have flange by mechanical joint ends. Flange bolts and nuts at these locations shall be stainless steel.

C. Fittings for PVC pipe 2-inches in diameter and smaller shall be Schedule 40 PVC. Fittings shall be solvent-weld socket fittings except where there is a change in pipe material.

2.6 MECHANICAL JOINT FITTING & PUSH-ON JOINT RESTRAINTS

A. Mechanical joint fitting restraints for Ductile Iron pipe and PVC pipe sizes 4-inches thru 24-inches shall be rated in accordance with the performance requirements of ANSI/AWWA C111/A21.11 Rubber Gasket Joints for Ductile-Iron Pressure Pipe and Fittings and meet or exceed the requirements of ASTM F1674 of the latest revision for PVC pipe.

1. Mega-Lug® type as manufactured by EBAA, Inc. Series 1100 for Ductile Iron pipe and series 2000PV for PVC pipe, OR:

2. MJ FIELD LOK® Gasket as manufactured by US Pipe and Foundry.

B. Push-on Joint Restraints for Ductile Iron:

1. FIELD-LOK 350 gaskets as manufactured by US Pipe & Foundry, no substitutions, are required for all ductile iron pipe installations, unless waived by Stanford Water Resources and Civil Infrastructure.

C. Internal Joint Restraint System for PVC

1. An internal joint restraint system, Eagle Loc 900 by JM Eagle, or equivalent, is required for all PVC pipe installations, unless waived by Stanford Water Resources and Civil Infrastructure. Concrete thrust restraints are not required on restrained joint pipes except when required at tie-in locations to unrestrained pipes.

2.7 GATE VALVE

A. Buried gate valves 3-inches thru 12-inches diameter shall be Mueller resilient wedge gate valve model A-2361 series, 350 psi working pressure, class 125 flanges, type 316 stainless
steel non-rising stem with square operating nut (turned counterclockwise to open), and -“O” ring packing; no substitutions.

B. Gate valves 2-inches and smaller shall be Milwaukee model UP105 gate valve with hand wheel, no substitutions.

C. For above ground gate valves in domestic and fire service systems, including backflow prevention assemblies and other locations with hand wheel, see Section 2.14 below.

2.8 BUTTERFLY VALVE

A. Buried Butterfly valves 14-inches thru 36-inches diameter shall be AWWA C504, Class 150B Mueller Lineseal III, No substitutions.

B. Furnish with enclosed operators with two-inch square operating nut. Nut turned counterclockwise (left) to open.

2.9 TAPPING SLEEVE AND VALVE

General: Taps are not allowed on mains that are smaller or equal in size to the lateral.

A. Tapping sleeves for 4-inches thru 12-inches mains shall be cast iron, 200 psi working pressure; Mueller H-615/H-619; no substitutions.

B. Tapping valves shall be Mueller resilient wedge gate valve model A-2361 or A-2362, 250 psi working pressure, non-rising stem with 2-inches square operating nut (turned counterclockwise to open), and "O" ring packing; no substitutions, with flanged or mechanical joint ends.

C. Tapping sleeves and valves for mains 14-inch diameter and larger shall be Mueller H-615 or approved equal.

2.10 SERVICE SADDLES

A. Service saddles for pipes 4-inches thru 12-inches diameter shall be Mueller BR2B Double strap bronze with AWWA I.P. thread. Tap diameter to match service connection size. No substitutions.

B. Pipes 14-inches thru 36-inches diameter shall be Smith Blair model 317 with fusion nylon coated body, 2 inches IP threaded outlet, double stainless steel straps and stainless steel bolts and nuts.

C. For PVC C900 water mains, service saddles shall be Mueller #H13000 series saddles.

2.11 AIR RELEASE VALVES

A. Combination air release / vacuum relief valves shall be cast-iron body, threaded inlets, stainless steel trim, floats, seats, and linkage. Air release valves shall be Crispin universal air-vacuum type UL10, 20 or Val-Matic 200 series, no substitutions.

B. Corporation stops (for use with air release valve connections): Corporation stops shall be two inches (2-inches) size, cast bronze body, plugs, and trim, and IP threaded for saddles,
C. Air release/relief valve pipe shall be 1-inch diameter for mains 12 inches in diameter or smaller, or 2-inch diameter for all other sized mains.

2.12 WATER VALVE BOX

A. A valve box shall be provided for each buried valve. Water valve boxes shall be pre-cast concrete box with steel or cast iron traffic cover marked "WATER" as detailed on the Plans; Christy Box #G5 with C275 cover; no substitutions.

2.13 VALVE STEM EXTENSIONS

A. Valve stem extensions shall be Fiberplas valve extensions as manufactured by Pipeline Products. Valve stem extension shall consist of Fiberplas upper operating nut (FPU-210), 2-inches square Fiberplas extension tubing (FPT-200), and Fiberplas lower operating nut (FPL-220).

2.14 DEBRIS CAPS

A. Debris caps installed in all valve boxes shall be DC825 as manufactured by SW Services. Depending on the water system, colors for handles shall follow standard detail CS-102.

2.15 BACKFLOW PREVENTION ASSEMBLY

Backflow prevention assembly shall be 150-psi minimum working pressure-rated, complete with two independently operating check valves, pressure-reducing feature where applicable, two resilient seat gate valves or ball valves, and test cocks. No substitutions for the following models:

A. Domestic Service Double Check Reduced Pressure Backflow Assemblies:

1. 3/4-inch through 2-inch diameters: Zurn Wilkins 975XL2 or Febco Model LF825Y

2. 4-inch through 10-inch diameters: Zurn Wilkins model 375AST (flanged body, flanged NRS valves); upon approval from Stanford, Zurn Wilkins model 475ST can be used.

B. Fire Service Backflow Detector Assemblies:

1. Double Check Reduced Pressure Backflow Assemblies 4-inch through 12-inch diameters: Zurn Wilkins model 375ASTDA (flanged body, flanged OS&Y valves); upon approval from Stanford, Zurn Wilkins model 475STDA can be used.

2. Double Check Backflow Assemblies 4-inch through 12-inch diameters: Wilkins 350DA (flanged body, OS&Y valves).

C. Domestic water gate valves 3inch thru 10-inch diameters shall be resilient wedge gate valve, 250-psi working pressure, non-rising stem with square operating nut (turned counterclockwise to open), and "O" ring packing, with flanged ends and hand wheel (turned counterclockwise to open).

D. Fire backflow gate valves assemblies shall be Wedge gate valve, 250 psi working
pressure-rated, outside screw and yoke (O.S. & Y.), with flanged ends and hand wheel (turned counterclockwise to open.

E. Backflow prevention assembly shall be installed with 12-inches minimum clearance above grade measured from the relief valve. The maximum installation height is 30” measured from the horizontal centerline of the backflow body to the finished grade.

F. Pipe used in backflow prevention assemblies and risers 3-inches thru 12-inches shall be flanged ductile iron pipe, minimum Class 53. Pipe used in backflow prevention assemblies and risers less than 2-inches shall be threaded red brass.

G. Fittings used in backflow prevention assemblies 4-inches thru 12-inches shall be flanged cast iron. Fittings used in backflow preventions less than 4-inches shall be threaded brass.

H. Backflow prevention assemblies’ 4-inch thru 12-inch diameters shall be painted black with a satin finish using Sierra/Rust-Oleum Performance Metalmax DTM paint.

2.16 FIRE HYDRANT (FH) & PROTECTIVE BOLLARDS

A. Fire hydrants on the domestic water system shall be Clow No. 960 and fire hydrants on the Lake Water system shall be Clow 76. Each hydrant shall have break-off riser and 6-inches standard ductile iron bury with mechanical joint ends. Stainless steel break-off bolts may be substituted for break-off riser as approved by Stanford Utilities Division.

B. Protective Bollards:

1. Post: Six feet long, 4-inches O.D. tube made from 11-gauge galvanized cold rolled steel filled with concrete grout and painted white.

2. Paint Coating:
   
   i. White - Kelly Moore Weather Shield Exterior Gloss Alkyd Enamel 1225 or approved equal.

   ii. Red - Kelly Moore Weather Shield Exterior Gloss Alkyd Enamel 1225 or approved equal.

2.17 WATER SERVICES

General: - Water services shall be sized as shown on the plans and shall be 1-inch minimum in size.

A. Water Services 2 inches and smaller: -- Water services 2 inches and smaller shall be copper. Service clamps, corporation stop valves, meter stops, and ball valves (on meter outlets) shall be installed for all services 2 inches and less unless otherwise shown. Service clamps shall be bronze, double strap, tapped for iron pipe size, Mueller BR2B for DIP or Mueller H-13000 series490/94 for PVC; no substitutions. Fittings shall be as below; no substitutions:

<table>
<thead>
<tr>
<th>SERVICE SIZE</th>
<th>CORPORATION STOP</th>
<th>ANGLE METER STOP</th>
<th>BALL VALVE</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
</table>

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### 2.18 WATER METER ASSEMBLY

#### A. Water meters shall be of the size indicated on the drawings with bronze flanges, red brass nipples and bronze meter spuds (where applicable), and registers reading directly in cubic feet. Meter assemblies, including bypass piping, shall be adjusted to finish grade using approved pipe and fittings, as follows:

1. **2-inches and smaller meters:** For 2-inches and smaller meters, meter assemblies shall be adjusted such that the meter registers are 6-inches below bottom of meter box lid.

2. **For 4-inches and larger meters:** Meter assemblies shall be adjusted such that the top of valve handwheels are 3-inches below the bottom of the meter enclosure lid.

#### B. Domestic Meters shall be as specified below; no substitutions:

1. 1-inch: Badger Meter 70 (bronze body and bottom)
2. 1-1/2 inch: Badger Turbo 160
3. 2-inch: Badger Turbo 200
4. 3-inch: Badger Turbo 450
5. 4-inch: Badger Turbo 1000
6. Larger then 4-inch: As approved by Stanford Utilities.

#### C. Lake Water Meters shall be specified below; no substitutions:

1. 1-inch: Badger Meter 70 (bronze body and bottom)

#### Table: Pipe Types

<table>
<thead>
<tr>
<th>Diameter</th>
<th>Manufacturer 1</th>
<th>Manufacturer 2</th>
<th>Manufacturer 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-INCH</td>
<td>MUELLER H-15028</td>
<td>MUELLER H-14258</td>
<td>MUELLER B-24337</td>
</tr>
<tr>
<td>1-1/2-INCH</td>
<td>MUELLER H-15023</td>
<td>MUELLER H-14277</td>
<td>FORD BF 13-666W-NL or MUELLER B-24337</td>
</tr>
<tr>
<td>2-INCH</td>
<td>MUELLER H-15023</td>
<td>MUELLER H-14277</td>
<td>FORD BF 13-777W-NL or MUELLER B-24337</td>
</tr>
</tbody>
</table>

B. Water Services 4 inches and larger: Water services 4 inches and larger shall be constructed using pipe, valves, and fittings as herein specified for water mains and as shown on the plans.

C. Water Service Building Penetrations 3 inches and larger: Water service 3 inches and larger connection points are to be made on the interior of the building, with a minimum clearance of six (6) inches from the interior side of the building wall. Piping from outside the building to inside shall be ductile iron and piping material inside the building shall be copper. Refer to standard detail CS-317.
2. 2-inch: Badger Turbo 200
3. 3-inch: Badger Turbo 450
4. 4-inch: Badger Turbo 1000
5. Larger than 4-inches: As approved by Stanford Utilities.

2.19 AUTOMATIC METER READING SYSTEM

A. Badger Recordall Transmitter Register (RTR) with ITRON 100WP+ Endpoint ERT and factory calibrated for Stanford University.

B. An approved pre-cast reinforced concrete water meter enclosure shall be provided for each water meter assembly. The words "WATER" shall be cast in each concrete lid and welded in 2-inches high letters on each steel lid.

C. 1-inches: Christy B9 and extensions with 9FLD lid with 4-inches pea gravel bed.

D. 2-inches: Christy B36 and extensions with B36-61G checker plate lid with 6-inches pea gravel bed.

E. 4-inches and 6-inches: Christy B48 box and extensions with one-half 62D cover and one-half 62G cover (checker plate with reading lid over meter) with a 6-inches thick pea gravel bed providing 3-inches clearance below the bottom of the meter assembly. Shop drawings for meter vault/pits and lids including meter assembly, piping layout, and required clearances shall be submitted for approval.

F. All fittings used in 4-inches and larger water meter assembly shall be flanged ductile iron.

G. For meters located in landscaped areas or areas not rated for H-20 traffic loading, meter box lids shall be Christy/Oldcastle Fibrelyte.

2.20 THRUST BLOCKS

A. Thrust blocks shall be constructed of Caltrans designated Class A concrete, and be mixed and delivered to the jobsite by an approved ready-mix concrete supplier, unless otherwise approved by the Stanford Utilities.

2.21 TRACER WIRE

A. A tracer wire shall be installed to facilitate the detection of all mains 4 inches and larger. Tracer wire shall be positioned and installed as shown on standard details. Tracer wire shall be THNN, 8 gauge copper wire, and solid blue in color. All wire shall be joined by use of a wire clamp. These connections shall be sealed and taped to create a watertight connection.

2.22 WARNING TAPE

A. All buried pipelines shall have plastic warning tape installed a minimum of 12 inches above the top of the pipelines. The warning tape shall be a minimum of 2 inches wide.

B. Warning Tape Color and Lettering:
1. Domestic water: Blue with black lettering reading “CAUTION, DOMESTIC WATER MAIN BURIED BELOW

2. Lake Water: Blue with black lettering reading “CAUTION, NON-POTABLE WATER MAIN BURIED BELOW

PART 3 - EXECUTION

3.1 STRUCTURES AND APPURTENANCES

Except as noted herein or on the plans, all water system structures, components, and appurtenances shall be constructed and installed in accordance with the applicable AWWA specifications.

Install debris caps for all valve boxes as required per standard detail CS-102. Existing debris caps from valve boxes that are abandoned or removed shall be salvaged and reused on new valve boxes for the Project or returned to Stanford’s Water Shop.

3.2 FIRE HYDRANTS

A. Install fire hydrants per standard details CS-171, CS-172, CS-174 or as detailed on plans.

B. Face and top of curb shall be painted red for 15 feet on each side of the fire hydrant or as detailed on plans.

C. Fire hydrant shall be primed and painted white.

D. Lake Water hydrants shall have painted red top.

E. Delineator: Install blue reflective pavement delineator

3.3 MINIMUM COVER FOR UNDERGROUND LINES

A. Water lines 4 inches and greater diameter: 42-inches minimum cover.

B. Water lines less than 4 inches diameter:

1. Paved areas: 42-inches minimum cover.

2. Landscaped and unimproved areas: 36-inches minimum cover.

3.4 THRUST BLOCKS

A. Thrust block locations may not be shown on the drawings, but blocks shall be provided for all pressure pipe fittings, changes in pipe alignment/direction, and at all other points where there is a possibility of joint separation under pressure. Provide anchors and supports where necessary for fastening work into place. Make proper provisions for expansion or contraction of pipelines. Thrust blocks shall be placed between solid ground and the pipe or fittings to be anchored as detailed. Thrust blocks shall be as detailed on the drawings, or where not detailed, in accordance with AWWA C600 and pipe manufacturer's recommendations.

B. Where concrete thrust blocking is not possible due to space limitations or unstable soil
conditions, the Contractor shall provide an alternate means of thrust restraint. Thrust restraint methods shall conform to NFPA 24 requirements. Acceptable methods include mechanical joint ductile iron retainer glands, restrained mechanical joints, and restrained push-on joints. Tie rods shall not be used unless tie rod materials, tie rod arrangement, and corrosion protection methods have been specifically submitted and approved by the Stanford Utilities Department for the actual field conditions encountered.

C. Backfilling operations at thrust blocks may begin as soon as the concrete has set sufficiently to remain in position and withstand the weight of the earth. Concrete shall not be disturbed or pressure loaded for at least five (5) days after placing unless otherwise permitted by Stanford Utilities.

3.5 HYDROSTATIC PIPELINE TESTING

A. After the pipe has been laid and backfilled it shall be subjected to hydrostatic pressure tests. Tests shall not be conducted until at least 12 hours have elapsed since pipe laying and at least five (5) days have elapsed since placing of concrete thrust blocks. The pipe shall be filled with water, which shall remain without external application of pressure for 24 hours before tests are conducted.

B. Prior to hydrostatic testing, flush pipe system with fresh water until piping is free of dirt and foreign matter.

C. Pressure shall be applied by a pump and measured by a test gage. The Contractor shall furnish all necessary apparatus and labor for conducting the pressure and leakage tests.

D. The Contractor is responsible to ensure the release of air from the line during filling, as well as the prevention of collapse due to vacuum when dewatering the line.

E. For pressure test, use a hydrostatic pressure not less than 200 psi. The duration of the test shall not be less than 4 hours. The pressure shall not drop by more than 0 psi for the duration of the test.

F. For portions of new mains with butterfly valves, use a hydrostatic test pressure of not less than 150 psi. The duration of the test shall not be less than 4 hours. The pressure shall not drop by more than 0 psi for the duration of the test.

3.6 DISINFECTION

A. General: All domestic water lines, mains, and branches shall be disinfected by chlorination in accordance with AWWA C601 and as herein specified. Chlorine shall be a 1 percent solution (containing 10,000 parts per million available chlorine) or shall be obtained by use of dry chlorine in tablet form firmly attached to inside top of the pipe.

B. The weight of chlorine or chlorine compound required to make a 1 percent chlorine solution is as follows:

1% CHLORINE SOLUTION TABLE

<table>
<thead>
<tr>
<th>PRODUCT</th>
<th>AMOUNT OF PRODUCT</th>
<th>QUANTITY OF WATER (GALLONS)</th>
</tr>
</thead>
</table>
The required concentration of chlorine in the pipe is 50 parts per million. This concentration may be attained by adding 5 gallons of the chlorine solution to 1,000 gallons of water.

D. The required concentration of chlorine in the mains may be obtained by the use of HTH tablets as produced by Olin Mathieson in the following quantities:

1. HTH TABLET (70%) DOSAGE

2. Number of Tablets Per Length of Pipe

<table>
<thead>
<tr>
<th>Length of Section</th>
<th>DIAMETER OF PIPE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4&quot;</td>
</tr>
<tr>
<td>13'</td>
<td>1</td>
</tr>
<tr>
<td>18'</td>
<td>1</td>
</tr>
<tr>
<td>20'</td>
<td>1</td>
</tr>
<tr>
<td>30'</td>
<td>2</td>
</tr>
<tr>
<td>36'</td>
<td>2</td>
</tr>
<tr>
<td>40'</td>
<td>2</td>
</tr>
<tr>
<td>100'</td>
<td>4</td>
</tr>
</tbody>
</table>

E. Liquid Chlorine Solution Method: All foreign matter shall be flushed from mains, branch runs, hydrant runs, and installed services. Liquid chlorine solution shall be introduced at appropriate locations to assure uniform distribution through the facilities at the proper concentration. Installed copper service lines shall not be used to convey the concentrated solution to the mains. The sanitizing solution shall be retained in the facilities for a period of 24 hours after which each service, hydrant run, branch run and dead end shall be flushed until the residual chlorine is less than one part per million or is no greater than the concentration of chlorine in the water supplied for flushing.

F. HTH Tablet Method: Tablets are to be fastened to the inside top surface of each length of pipe using "Permatex No.1" no earlier than the day pipe is laid. Tablets shall not be installed in the pipe and left overnight before laying and shall not be accessible at any time for casual pilferage by the general public or by children. Tablets shall be stored in a hermetically sealed container. The new facilities are to be slowly filled with water. Air is to be exhausted from each dead end, branch run, hydrant run, and installed service. Water shall be retained for a period of 24 hours, after which each service, hydrant run, branch run and dead end shall be thoroughly flushed to clear foreign matter and until the residual chlorine concentration is less than one part per million or is no greater than the concentration of
chlorine in the water supplied for flushing. Stanford Utilities shall approve the method of dechlorination prior to flushing and disposing of heavily chlorinated water.

3.7 BACTERIOLOGICAL TESTING

A. Samples shall be gathered and tests conducted at the expense of the Contractor by a laboratory approved by Stanford Utilities. Samples are to be taken at representative points as required by Stanford Utilities.

B. The new facilities shall remain isolated and out of service until satisfactory test results have been obtained which meet the requirement of the California Department of Public Health and until Stanford Utilities has accepted the results as indicative of the bacteriological condition of the facilities. If unsatisfactory or doubtful results are obtained from the initial sampling, the chlorination process shall be repeated until acceptable test results are reported.

3.8 FIRE SERVICES

A. Fire services consist of underground and above ground piping between the domestic water main and the building entrance, including double check valve assemblies, fire department connections, post indicator valves, check valves, fire hydrants, and other appurtenant facilities. Fire services shall comply with these specifications and standard details in addition to the requirements of the University Fire Marshal. Drawings showing proposed fire services shall be submitted to the Stanford Utilities Department for review and approval prior to submitting to the University Fire Marshal (and then to the Santa Clara County Fire Marshal for permitting). Any Stanford Utilities Department requirements not acceptable to the Fire Marshal shall be submitted to the Stanford Utilities Department for clarification and/or resolution.

3.9 REMOVING AND ABANDONING EXISTING DOMESTIC AND LAKE WATER MAINS AND RELATED STRUCTURES

A. General

1. Contractor shall remove, plug and fill, or break open, domestic and lake water mains and related structures as shown on the plans, or where necessary for the proper completion of the work, including all excavating, backfilling, restoring pavement, and other incidental work.

2. All openings of domestic and lake water mains or related structures abutting sections to be removed or broken open shall be satisfactorily sealed at all open ends with caps or concrete and all contained storm runoff and debris removed unless otherwise specified.

B. Remove

1. Existing domestic and lake water mains, structures and appurtenances, including tie-ins, which have been or are to be abandoned, and lie within a water main trench or structure excavation, shall be removed from within the limits of required excavation necessary for the work.
2. All domestic and lake water mains, structures and appurtenances, except laterals, identified to be removed shall be removed to a depth of at least four feet below finished grade and broken in a manner that will prevent water entrapment, and all contained water and debris removed.

C. Abandon

1. All domestic and lake water mains identified to be abandoned shall be plugged and filled as described below.

   a. Plug and Fill: Domestic and lake water mains to be abandoned, which lie three feet or deeper below street grade or ground surface, shall be thoroughly sealed at all open ends, and at the structures in which they terminate, as applicable, and shall be filled with an approved slurry grout.

      The plugging at the ends of water mains to be filled with slurry grout may be accomplished by the use of temporary plugs or bulkheads which shall be removed after the slurry mix has set.

   b. Plug: Water mains and tie-ins to be plugged shall be sealed at all open ends and at the structures in which they terminate, as applicable, with 12-inch thick concrete plugs.

   c. Fill with Slurry Grout: Water mains and related structures to be plugged and filled shall be filled with a slurry mixture containing a minimum of 2 sacks of Type II cement per cubic yard of mixture.

      Filling with slurry may be accomplished by pumping or gravity, at the option of the Contractor, and will be checked by comparing the computed volume of the water main with the volume of mixture used. If the computed volume is more than 10 percent greater than the actual volume of slurry used, the Contractor shall excavate two exploratory holes where directed, and shall do all work necessary to satisfactorily fill any encountered voids.

      Any damage to existing facilities resulting from the use of slurry grout shall be satisfactorily repaired by the Contractor at his own expense and no direct or additional payment will be made for such repair.

      Water main tie-ins shall not be filled with slurry grout, unless specified.

END OF SECTION