FMOC

Specification Section 02516 Flushing and Disinfection of Underground Water Lines For Domestic and Fire Protection Systems

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Revision 1

This document has undergone formal review and approval and been reviewed by a Derivative Classifier and its contents have been deemed unclassified/unlimited release.

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Change Log

Rev. No.	By	Date	Type	Change Description	ID
1	MA/SM/LEO	7/12/12		Incorporated changes from Marti Adams and branded to FMOC standard template. Light editing changes.	

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1.0 Part 1 – General

1.01 Summary

A. Section Includes:

1. Discharge requirements
2. Flushing requirements for underground water mains
3. Disinfection requirements for the following new and repaired systems:
   a. Underground potable water distribution piping
   b. Fire protection piping below grade to base of riser

1.02 References

A. ®American Water Works Association (AWWA)

1. C651 Disinfecting Water Mains
2. B300 AWWA Standard for Hypochlorites
3. NFPA® 13 Standard for the Installation of Sprinkler Systems
4. NFPA 24 Standard for the Installation of Private Fire Service Mains and Their Appurtenances

1.03 Submittals

A. General: Submit the following in accordance with conditions of contract and section 01330 *Descriptive Submittals*.

B. Flushing Plan as per 15401 to include:

(1) Disinfectant to be used

(2) Dechlorination to be used

1.04 Quality Assurance

A. All work shall comply with the applicable portions of the most current edition of the International Plumbing Code® and AWWA Standards.

B. The materials and practices comprising the work shall conform to this and other referenced specifications. Where this specification conflicts with the requirements of another referenced specification, this specification shall be used.

C. All people performing or supervising testing shall be qualified by either training or experience to perform such tests.

D. Sandia National Laboratories (SNL) will perform water quality testing of water samples taken from piping systems for chlorine concentrations and bacteriological quality. The contractor must coordinate water quality testing with the Sandia Delegated Representative (SDR) or Sandia Construction Observer (SCO) a minimum of 48 hours in advance.

2.0 Part 2 – Products

2.01 Acceptable Disinfectants

A. Sodium hypochlorite [NaOCl] conforming to AWWA B300 Standard for Hypochlorites.

B. Calcium hypochlorite [$Ca(OCl)_2$] granules and tablets conforming to AWWA B300 Standard for Hypochlorites. Calcium hypochlorite intended for use in swimming pools is not permitted.

C. Disinfection with pure chlorine gas or liquid is not permitted.

2.02 Acceptable Dechlorination (Neutralizing) Agents

A. Sodium thiosulfate (technical grade, prismatic rice) is acceptable for all discharges, except to an active watercourse or storm sewer.

B. Vitamin C salt (sodium ascorbate, Vita-D-Chlor brand or equal) must be used when discharging to an active watercourse.

C. Sulfur dioxide gas is not permitted.

3.0 Part 3 – Execution

3.01 Discharge Requirements

A. The contractor shall obtain approval through the Construction Observer to discharge the surface from the Environmental Programs Department (4143), two days prior to any discharge.

B. Discharges to environment:

1. Discharges shall not cause or have the reasonable potential to cause or contribute to a violation of a water quality standard.

2. Employ Best Management Practices to prevent erosion from discharge of water during any construction activities including flushing and disinfection in accordance with an approved Storm Water Pollution Prevention Plan .

3. Chlorinated water used for disinfection shall be dechlorinated with an approved dechlorination agent. If discharge is not to a watercourse (e.g., flat ground), then total chlorine concentration shall be reduced to less than 1 ppm (part per million). Discharges to a watercourse require approval from the Environmental Programs Department (4143), prior to any discharge. Do not dose neutralizing chemical beyond the minimum required to neutralize the chlorine present in discharge. Allowable residual chlorine will vary depending on discharge avenue (watercourse, flat land, or sanitary sewer system).

4. For discharges of less than 5,000 gallons, notify the Construction Observer at least 48 hours (2 working days) in advance of planned discharge.

5. For discharges of 5,000 gallons or more, notify the Construction Observer at least five working days in advance of planned discharge.

C. Notify the Construction Observer immediately in the event of any accidental discharge.

3.02 Flushing of Water Mains

A. Preliminary flushing:

1. Prior to flushing and disinfection, fill main with water to eliminate air pockets.

2. The contractor shall flush all new installations in accordance with an approved flushing plan submitted by the contractor and approved by the SNL Facilities Management and Operations Center Water System Engineer. If no fire hydrants or other convenient outlets for flushing are available, the contractor shall install flush points at no additional cost to SNL. All discharges must meet requirements in section 3.01 of this specification. The contractor shall coordinate operations by submitting a support request to the SDR or SCO a minimum of 48 hours in advance. Operations requiring a system outage must be coordinated a minimum of two weeks in advance.

3. Flush new mains, including fire service mains and lead-in connections to fire system risers, thoroughly before connection is made to system piping in order to remove foreign materials that might have entered the main during the course of the installation or might have been present in existing piping.

4. Flushing shall be of sufficient magnitude and duration to flush all foreign material out of the lines, valves, and hydrants. The flushing velocity shall be a minimum of 2.5 feet per second (ft/s) for non-fire protection lines. Where the main supplies a fire protection system, the velocity shall meet the NFPA 24 requirement of 10 ft/s.

Flow required to produce a velocity of 10 ft/s (3 meter per second [m/s]) in pipes (NFPA 24):

Nominal Pipe Size	
Inches (in.)	Gallons per Minute (gpm)
4	390
6	880
8	1560
10	2240
12	3520

5. All valves and hydrants shall be fully opened and closed under water pressure to ensure proper operations during flushing and to dislodge foreign material. All valves on fire protection lines (except curb box valves), shall be sealed with a plastic seal in the normal position (opened or closed) at the conclusion of testing. During flushing operations, all valves or connections to existing systems shall be closed and backflow preventors or other approved equipment installed at the source to prevent contamination of existing systems.

6. Contractor shall protect existing site improvements during flushing operation.

B. Final Flushing

Clearing the main of heavily chlorinated water:

1. Contact the SDR or SCO to arrange for water quality testing for chlorine concentrations and bacteriological quality at a minimum of 48 hours in advance of the final flushing.

2. After a residual free chlorine concentration test has been completed by SNL, flush the piping system with potable water until total chlorine concentration in main is less than 2 milligrams per liter (mg/L) or 2 ppm, but not less than 0.2 mg/L or 0.2 ppm. All discharges must meet requirements in section 3.01 of this specification.

3. After final total chlorine concentration and bacteriological quality tests have been completed, the SCO will furnish the test results to the Project Manager (PM). If the water quality tests do not show compliance with the applicable requirements of the Safe Drinking Water Act, the main shall be flushed, re-chlorinated, and retested until test results demonstrate compliance.

3.03 Disinfection of Water Mains

Disinfection shall follow the Requirements of AWWA Standard 651 for Disinfecting Water Mains latest edition.

Disinfecting solutions containing chlorine shall not exceed 12% active chlorine; greater concentrations can chemically attack and degrade polyethylene.

A. Disinfection by Chlorinated Water Injection

1. Inject chlorinated water with a free chlorine concentration no less than 25 mg/L, into the water line; no more than 10 feet from the beginning of the new main. Provisions shall be taken to eliminate air pockets.

2. Chlorinated water shall remain in the pipe for a minimum of 24 hours. If the water temperature is less than 41°F (5°C), it shall remain in the pipe for a minimum of 48 hours. Detectable chlorine residual should be found at each sampling point after the 24 hour or 48 hour period. Contact the SCO to arrange for residual chlorine testing a minimum of 48 hours in advance.

B. Tablet Method: Only applicable for projects where the pipes and appurtenances are kept clean and dry. This method must be indicated in the flushing plan. The flushing plan must clearly indicate the sequence of events to assure the line is disinfected properly and flushing requirements are met.

1. **Warning:** This procedure cannot be used on solvent-welded plastic or on screwed-joint steel pipe because of the danger of fire or explosion from the reaction of the joint compounds with the calcium hypochlorite.

2. Five-gram (g) calcium hypochlorite tablets shall be placed in each section of pipe during construction. The number of tablets shall be .0012 d^2L rounded to the next largest integer, where (d) is the inside diameter in inches, and (L) is the length of pipe in feet. One tablet shall also be placed in each hydrant, hydrant branch, or other appurtenances. Tablets shall be secured using food-grade adhesive to the top of the main, making sure the number of tablets on each end is approximately equal. If the pipe is to be placed in the trench, there must be markers indicating the pipe has been installed with the tablets on top.

3. When the installation has been completed, the main shall be filled with water at a rate to insure the water within the main will flow at a velocity no greater than 1 ft/s (0.3m/s). Precautions shall be taken to eliminate air pockets within the main. This water shall remain in the pipe for a minimum of 24 hours If the water temperature is less than 41°F (5°C), it shall remain in the pipe for a minimum of 48 hours. Detectable chlorine residual should be found at each sampling point after the 24 hour or 48 hour period. Contact the SCO to arrange for residual chlorine testing a minimum of 48 hours in advance.

C. Calcium hypochlorite granules: Granules shall be placed at the upstream end of the first section of pipe, at the upstream end of each branch main, and at 500-ft intervals. The granular quantity of calcium hypochlorite can be calculated using the table below:

1. **Warning:** This procedure cannot be used on solvent-welded plastic or on screwed-joint steel pipe because of the danger of fire or explosion from the reaction of the joint compounds with the calcium hypochlorite.

Calcium Hypochlorite Quantities per 500 linear feet.			
Pipe Diameter (d)		**Calcium Hypochlorite Granules**	
In.	(mm)	oz	g
4	100	1.7	57
6	150	3.8	113
8	200	6.7	200
10	250	10.5	300
12	300	15.1	430
14<	350<	D^2*15.1	D^2*427.9
Where D is the inside pipe diameter in feet (D = d/12)			

2. When the installation has been completed, the main shall be filled with water at a rate to insure the water within the main will flow at a velocity no greater than 1 ft/s (0.3m/s). Precautions shall be taken to eliminate air pockets within the main. This water shall remain in the pipe for a minimum of 24 hours. If the water temperature is less than 41°F (5°C), it shall remain in the pipe for a minimum of 48 hours. Detectable chlorine residual should be found at each sampling point after the 24 hour or 48 hour period. Contact the SCO to arrange for residual chlorine testing a minimum of 48 hours in advance.

D. After the residual chlorine testing has been accomplished, the contractor shall perform the *Final Flushing* as prescribed in section 3.02 of this specification.

3.04 Disinfection for Repairs

Disinfection shall follow the Requirements of AWWA Standard 651 for Disinfecting Water Mains latest edition.

A. Before Repair:

1. Where practical, isolate a section of the affected line and shut off all service connections.

2. Swab or spray the inside of new pipe and fittings with a minimum of 1 percent (10,000 ppm) hypochlorite solution before they are installed. Disinfect tools to be used in same manner.

B. After Repair:

1. Prior to disinfection, flush affected line to remove any debris that may have been introduced during repairs. If possible, flush from both directions. Flush until discolored water is eliminated and water flows clear. If line segment cannot be isolated, thoroughly flush the segment to a tank or through a fire hydrant.

2. Obtain verification from the SCO that the affected line has been thoroughly flushed and is ready for chlorination.

3. Apply chlorinated water to the interior surfaces of affected water line segment at the chlorine concentration and contact times as follows; verify total chlorine concentration by performing an initial total chlorine concentration test.

Chlorine Concentration (mg/L, ppm)	**Minimum Contact Time**
300	15 minutes
250	1 hour
200	1.5 hours
150	2 hours
100	3 hours

4. Flush affected line with potable water until total chlorine concentration in main is less than 1 mg/L (1 ppm) or the prevailing chlorine concentration in the water system is achieved. Follow the discharge requirements defined in section 3.01 *Discharge*.

5. After flushing, contact the SCO 48 hours prior to testing to arrange for final total chlorine concentration and bacteriological quality tests.

6. After final total chlorine concentration and bacteriological quality tests have been completed, the SCO will furnish the disinfection report to the PM. If water quality tests do not show compliance with water quality requirements, repeat disinfection process until test results demonstrate compliance.

7. Alternatively the *Slug Chlorination* procedure as defined in AWWA C651 may be followed for chlorination of the repair.

END OF SECTION