SECTION 22 0816

DISINFECTION OF POTABLE WATER PIPING

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LANL MASTER SPECIFICATION SECTION

Word file at <https://engstandards.lanl.gov>

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| Rev. 6 Summary of Changes: New attachment for small scope work. Minor clarifications and corrections, including ES-UI, ESH, Neutralization moved to 01 3545, R8, *Water Discharge Requirements*, other minor updates. |

This template must be edited for each project.  In doing so, specifier must add job-specific requirements.  Brackets are used in the text to indicate designer choices or locations where text must be supplied by the designer.  Once the choice is made or text supplied, remove the brackets.  This section must also be edited to delete specification requirements for processes, items, or designs that are not included in the project -- and specifier’s notes such as these.  To seek a variance from requirements that are applicable, contact the LANL Water Quality Group followed by the Engineering Standards Manual (ESM) Mechanical[POC](http://engstandards.lanl.gov/POCs.shtml#mech). Please contact POC with suggestions for improvement as well.

When assembling a specification package, include applicable specifications from all Divisions, especially Division 1, General Requirements.

Specification developed for Management Level (ML)-4 projects.  For ML-1, 2, and 3 applications, additional requirements and independent reviews should be added if increased confidence in procurement or execution is desired; see ESM Chapter 1, Section Z10, Specifications and Quality.

**USAGE NOTE:** This basic template should be used for a Division 22 section and/or Division 33 section depending on project scope (both divisions when scope includes both). When used for Division 33, engineer of record (EOR) must change the section number to 33 1000 and title that section “Disinfection of Water Utility Distribution.”
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1. GENERAL
	1. SECTION INCLUDES
		1. Disinfection requirements for the following new, repaired, or modified systems:
			1. Potable water distribution piping [on Project site and within buildings]
			2. [Fire protection piping below grade to base of riser]

Note: Disinfection of non-potable water piping, including fire protection piping downstream of alarm check valve or fire line backflow preventer, is not required.

* 1. LANL PERFORMED WORK
		1. Water quality testing: a LANL subcontract technical representative (STR) will coordinate water quality testing of water samples taken from piping systems for chlorine concentrations and bacteriological quality. The LANL Utilities and Institutional Group (U&I) will approve the use of disinfected piping when test results demonstrate conformance with water quality requirements as described in Paragraph 1.5.D, furnishing disinfection report to Subcontractor.
	2. REFERENCES
		1. American Water Works Association, C651-[2014] Disinfecting Water Mains.
		2. New Mexico Administrative Code, Title 20.7.10 Drinking Water, Section 400.
	3. ACTION SUBMITTALS
		1. Submit the following test results:
			1. Free chlorine concentration during disinfection
			2. Bacteriological test (coliform bacteria)
			3. Residual free chlorine concentration, after flushing out chlorinated water
		2. Test Reports: Submit test results within 5 working days of successful test to LANL STR and LANL U&I water system representative.
	4. DESCRIPTION
		1. Disinfection
			1. Protect interiors of pipes, fittings, and valves against contamination during construction.
				1. Pipe delivered for construction shall be strung to minimize entrance of foreign material.
				2. Close openings of pipeline when pipe-laying is stopped either at end of workday or for other reasons, such as rest breaks or meal periods.
			2. Do not disinfect any pipe until source of potable water supply used for flushing or disinfection is approved by LANL STR.
			3. LANL will perform water quality testing of water samples taken from piping systems for chlorine concentrations and bacteriological quality as described in Paragraph 1.5.D. Samples for testing are not compliance samples and should be marked as “special purpose.”
			4. Do not place piping in service until notified by LANL STR that water quality test results are approved by LANL, as described in Paragraph 1.5.D.
			5. Re-flush and retest disinfected potable water piping that has been allowed to stand stagnant for more than 30 days before being placed in service.
			6. Disinfect piping within building with service taps and fixtures installed. Flow chlorinated water and flush water through lavatories, sinks, drinking fountains, showers, and hose bibs.
		2. Water Discharge – Subcontractor
			1. Refer to Section 01 3545, *Water Discharge* *Requirements*. Neutralize chlorinated water used for disinfection prior to discharge as described therein.
			2. Obtain approval from LANL STR prior to ANY discharges.
		3. Water Quality Testing – Subcontractor
			1. Notify LANL STR at least 5 working days in advance to arrange for a bacterial quality or free or total chlorine concentration test.
			2. Requirements for demonstration of water quality conformance:
				1. Total residual chlorine concentration of less than 1 mg/L (1 ppm)
				2. The absence of any coliform bacteria
				3. At discretion of LANL STR, a heterotrophic plate count (HPC) showing bacteria less than 500 colony-forming units (cfu) per mL sample
		4. Water Quality Testing – LANL STR
			1. The STR will make advance arrangements for a total chlorine concentration test, bacterial quality test, or for monitoring batch-treated discharge for pH and chlorine.
			2. The STR will verify that water samples for piping in the distribution system (public water system) are analyzed by a water sampler technician certified per New Mexico [NMAC](http://164.64.110.239/nmac/_title20/T20C007.htm) 20.7.4.12.C; furthermore, it is recommended that a qualified sampler collect all the testing samples.
1. PRODUCTS
	1. MATERIAL SAFETY DATA SHEETS
		1. Maintain on site material safety data sheets (MSDS) for chemical products, including disinfection and dechlorination products.
	2. ACCEPTABLE DISINFECTANTS
		1. Sodium hypochlorite solution (bleach) per AWWA B300 contains approximately 5%–6% available chlorine, or 50,000 to 60,000 ppm.  Thus, a 1:1,000 dilution of bleach in water results in a chlorine concentration of about 50 ppm. Use care in control of conditions and length of storage to minimize its deterioration.
		2. Calcium hypochlorite [Ca(OCl)2] granules and tablets per AWWA B300. This contains approximately 65% available chlorine by weight. It will not readily dissolve in water with a temperature of less than 41°F. Store in a cool, dry, and dark environment to minimize its deterioration. Direct placement of solid phase into piping is not permitted. Do not use calcium hypochlorite intended for swimming pools (e.g., HTH), as this material has been sequestered and is extremely difficult to eliminate from the pipe.
		3. Disinfection with pure chlorine gas or liquid is not permitted.
	3. PRECAUTIONS
		1. Calcium hypochlorite is corrosive and is a strong oxidizer. Reducing agents (e.g*.*, sodium ascorbate or thiosulfate), concentrated acids, and organic compounds (e.g., antifreeze, gasoline), can oxidize, burn, or explode if they contact solid-phase calcium hypochlorite.
		2. Do not use calcium hypochlorite on solvent-welded plastic pipe or on screwed-joint steel pipe because of danger of fire or explosion from reaction with joint compounds (exception: PFTE “Teflon” tape).
		3. Disinfecting solutions containing chlorine shall not exceed 12% active chlorine; greater concentrations can chemically attack and degrade polyethylene.
2. EXECUTION
	1. DISINFECTION OF NEW WATER MAINS
		1. Preliminary flushing
			1. Prior to disinfection, fill main with water to eliminate air pockets.
			2. Follow Section 01 3545, *Water Discharge Requirements*, when discharging water.
			3. Flush new mains, including fire service mains and lead-in connections to fire system risers, thoroughly before connection is made to system piping to remove foreign materials that might have entered the main during the course of the installation or that might have been present in existing piping.
			4. The minimum rate of flow shall be greater than the water demand rate of the system, which is determined by the system design. Where the main supplies a fire supply sprinkler system (common at LANL), flow shall provide a National Fire Protection Association (NFPA) 24 velocity of 10 ft/s (3 m/s) even if the demand rate may be less. Flow/velocity table below.
			5. Follow AWWA C651, *Disinfecting Water Mains*, using Continuous Feed Method where practical.

**Exception:**  For mains supplying fire systems, when the flow rate as listed in table below cannot be verified or met, supply piping shall be flushed at the maximum flow rate available to the system under fire conditions. This maximum rate shall be calculated by the water sprinkler system designer for each situation with the existing system limitations, if any, taken into account. The designer shall then submit the water demand rate of the new system to FP-DO so they can set both the minimum rate of flow and the parameters for the test and flow rates. If such a designer is not involved in the project, then FP-DO will determine flush rate.

**Flow Required to Produce a Velocity of 10 ft/s (3 m/s) in Pipes (NFPA 24-2016)**

|  |  |
| --- | --- |
| Nominal Pipe Size (in.) | Flow Rate (gpm) (L/min) |
| 4 |  390 1476 |
| 6 |  880 3331 |
| 8 |  1560 5905 |
| 10 |  2440 9235 |
| 12 |  3520 13323 |

* + - 1. For all systems, continue the flushing operation for a sufficient time to ensure thorough cleaning.
			2. Obtain verification from LANL STR that system has been thoroughly cleaned (flushed) and is ready for chlorination.
			3. Perform piping pressure test before disinfection to avoid possible discharge of heavily chlorinated water due to pipe or joint failure during a pressure test.
				1. If an unplanned discharge occurs, notify EPC-CP immediately 664-7722.
		1. Chlorination of the Main
			1. Inject chlorinated water, with a free chlorine concentration of not less than 25 mg/L, into main at a point no more than 10 ft downstream from beginning of new main. Verify free chlorine concentration is not less than 25 mg/L by an initial free chlorine concentration test as described in Paragraph 1.5.D.
			2. Leave chlorinated water in main for at least 24 h during which time valves and hydrants in system shall be operated to ensure disinfection of the appurtenances.
			3. At end of the 24-hour period, treatment water in all portions of main shall have a residual free chlorine concentration of not less than 10 mg/L. Verify by test per Paragraph 1.5.D. Repeat disinfection if chlorine level is low.
			4. After residual free chlorine concentration test has been completed, flush system with potable water (in accordance with Section 01 3545, *Water Discharge Requirements*) until total chlorine concentration in main is less than 1 mg/L (1 ppm).
			5. After final flushing, contact LANL STR to arrange for final total chlorine concentration and bacteriological quality tests per Paragraph 1.5.D.
			6. After final total chlorine concentration and bacteriological quality tests have been completed, LANL STR will furnish disinfection report to Subcontractor and LANL U&I water system representative. If water quality tests do not show conformance with water quality requirements as described in Paragraph 1.5.D, then repeat steps 3.1B 1–5 above until test results demonstrate conformance.
	1. DISINFECTION OF NEW INTERIOR POTABLE WATER SYSTEM
		1. Flush until discolored water is eliminated and water flows clear, discharging per Section 01 3545, *Water Discharge Requirements*.
		2. Chlorination of piping
			1. Use chlorinated water with a free chlorine concentration of not less than 25 mg/L. Verify this by an initial free chlorine concentration test per Paragraph 1.5.D.
			2. Retain chlorinated water in piping for at least 24 h, during which time lavatories, sinks, drinking fountains, showers, and hose bibs shall be operated to ensure disinfection of appurtenances.
			3. At the end of the 24-hour period, treatment water in all portions of piping shall have a free chlorine concentration of not less than 10 mg/L. Subcontractor shall verify this minimum concentration by test per Paragraph 1.5.D.
			4. After residual free-chlorine concentration test has been completed, flush system with potable water until total chlorine concentration in piping is less than 1 mg/L (1 ppm), discharging per Section 01 3545, *Water Discharge Requirements*.
	2. DISINFECTION DURING AND FOLLOWING REPAIR OR MINOR MODIFICATION OF EXISTING MAINS OR INTERIOR PIPING

See Attachment A for further clarification.

* + 1. Before Repair
			1. Where practical, isolate a section of affected line and shut off all service connections.
			2. Swab or spray the inside of new pipe and fittings with a minimum of 1% (10,000 ppm) hypochlorite solution before they are installed. Disinfect tools to be used in the same manner.
		2. Flushing after Repair
			1. Prior to disinfection, flush the affected line to clean out contamination introduced during repairs. If possible, flush from both directions. Flush until discolored water is eliminated and water flows clear. If the line segment cannot be isolated, thoroughly flush the segment to a tank or through a fire hydrant. Follow requirements in Section 01 3545, *Water Discharge Requirements*, for notification and dechlorination requirements.
			2. Obtain verification from LANL STR that affected line has been thoroughly cleaned (flushed) and is ready for chlorination.
		3. Apply chlorine to water to expose interior surfaces of affected segment at the chlorine concentration and contact times as in the following table; verify total chlorine concentration by an initial total chlorine concentration test as described in Paragraph 1.5.D:

| Chlorine Concentration (mg/L, ppm) | Contact Time (h) |
| --- | --- |
| 300 | 0.25 |
| 250 | 1 |
| 200 | 1.5 |
| 150 | 2 |
| 100 | 3 |

* + 1. Retain chlorinated water in main, or piping, for above prescribed contact time. At the end of prescribed time period, flush affected line with potable water until total chlorine concentration in main is less than 1 mg/L (1 ppm).
		2. After flushing, contact LANL STR to arrange for final total chlorine concentration and bacteriological quality tests per Paragraph 1.5.D.
		3. After final total chlorine concentration and bacteriological quality tests have been completed, LANL STR will furnish disinfection report to Subcontractor. If water quality tests do not show conformance with water quality requirements per Paragraph 1.5.D, repeat steps above until test results demonstrate conformance.

END OF SECTION

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Do not delete the following reference information:
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THE FOLLOWING STATEMENT IS FOR LANL USE ONLY

This project specification section is based on LANL Master Specification Section 22 0816, Rev. 6, dated June 15, 2022.

**Attachment A, Spray/Swab Process for Small Segments**

This alternate disinfection method applies only for piping work segments 20 feet or less in length, fittings, valves, and for maintenance-like activities such as replacing drinking fountains, water faucets, backflow preventers, etc.

Bacteria (BacT) sampling for minor disinfections is at the discretion of ESH or ES-UI. Project personnel will verify by contacting the appropriate LANL Deployed Environmental Professional or by emailing: ui-drinkinwatersupport@lanl.gov.

Activities that qualify for spray/swab disinfection are as follows:

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| --- | --- | --- | --- |
| Activity | Spray/Swab Location (use concentrated chlorine solution\*) | Flushing Requirements | BacT Sample Location (s) |
| Installation of new water line up to 20 feet in length | entire interior length of new pipe | flush affected line with a minimum of 3 pipe and component volumes | each branch and end of pipe |
| Replacement of appurtenances or fixtures | within appurtenance and end fittings | same as above | appurtenance or fixture outlet |
| Repair of appurtenance or fixture piping | interior length of new pipe | same as above | appurtenance or fixture outlet |
| Fire hydrant, pipe fitting, and valve installation | fire hydrant piping, pipe fitting(s) and new valve(s) | same as above | end of pipe plus fire hydrant, pipe fitting, valves |
| Tapping valve installation | entire length of new valve/pipe | same as above | end of pipe |
| Backflow preventer repair, replacement, or installation | BFP and adjacent fittings | n/a | n/a |

\*Concentrated Chlorine Solution: All new pieces of pipe, couplings, clamps, sleeves, and other materials used in the repair must be thoroughly swabbed with a concentrated (1% available chorine or greater) chlorine solution to disinfect all surfaces that will come into contact with potable water. The concentrated chlorine solution may be prepared by adding 2 oz. of calcium hypochlorite (65% available chlorine) or 26 flo oz. of household bleach (5% available chlorine) to 1 gal. of water. Clean rags or a sprayer are typically used to apply the solution. Longer pieces of pipe may be disinfected using a clean mop.