

Carnegie Mellon University Environmental Health & Safety FIRE LAB WORK	Environmental Health and Safety Guideline for Free-Chlorine Sampling and Water Flushing
Date of Issuance: 04/08/2025	Revision Date:
Revision Number:	Prepared by: EHS

1. Introduction

Chlorine is a disinfectant used by the local public water supplier, Pittsburgh Water and Sewer Authority (PWSA), to reduce the presence of potentially harmful bacteria, such as Legionella, and other contaminants in water as it travels through pipes from the treatment and storage locations to the end users, including CMU.

The presence of a certain concentration of free chlorine in the water throughout a building indicates that fresh, disinfected water is flowing through the pipes of that building. This flow of fresh, disinfected water will further aid in reducing the risk for bacterial proliferation and contamination buildup.

2. Purpose

Carnegie Mellon University (CMU) has developed this guideline to outline best practices for water flushing and free chlorine sampling in CMU buildings.

The purpose of flushing as outlined in this guideline is to reduce the aforementioned risks associated with water stagnation in building plumbing systems.

Confirmatory sampling for free chlorine will verify if water flushing efforts are bringing in a sufficient volume of chlorinated water into and throughout the buildings' plumbing systems.

3. Scope

This guideline is to be used by Facilities Management and Campus Services (FMCS), Housing Services and Environmental Health and Safety (EHS) for water flushing and free-chlorine sampling best practices.

The activities described within this guideline are applicable to CMU-owned Housing and Dining facilities on the Pittsburgh campus. Academic and administrative buildings are included for tracking and trending purposes.

The plumbing systems covered within this guideline include water sources from the domestic water system, such as sinks, drinking water fountains and bottle fillers, toilets, and showers. Cooling towers, boilers, and water heaters are not covered within this guideline.

4. Definitions

- a. Distal Water Fixture: a water fixture that is further away from the water's main entry point into a building.
- b. Free Chlorine: the amount of chlorine in water that is available to kill pathogens and sanitize water. It's the most reactive form of chlorine and is used in water treatment for many purposes, including disinfection, controlling taste, color, and odor, removing contaminants (i.e. ammonia, hydrogen sulfide, iron, and manganese).
- c. Flushing: The action of moving large quantities of water through a water system.
- d. Unoccupied building: a building that has less than 50% occupancy.
- e. Water Fixture: sources of water, such as sinks, drinking water fountains, bottle fillers, toilets, and showers.

5. Roles and Responsibilities

- a. Environmental Health and Safety (EHS):
 - i. Assist with the review and interpretation of free-chlorine sampling results.
 - ii. Maintain documentation of sampling results.
 - iii. Assist with chlorine sampling equipment selection and troubleshoot equipment issues.
 - iv. Train FMCS personnel on free chlorine sampling and water flushing procedures.
 - b. Facilities Management and Campus Services (FMCS):
 - i. Follow the guidelines set forth in this document as necessary.
 - ii. Identify and maintain records on how water enters and flows through academic, administrative, and Housing buildings.
 - iii. Enter work orders or establish PMs to conduct flushing and free-chlorine sampling in academic and administrative buildings as needed.
 - iv. Ensure personnel involved with chlorine sampling and flushing complete training with EHS.
 - v. Maintain free-chlorine sampling equipment in good working order.
 - vi. Purchase consumable reagents for the sampling equipment, i.e. 10-mL free chlorine powder pillows, and other consumable items associated with the sampling process.
 - vii. Ensure plumbers respond to work orders and preventive maintenance activities requesting flushing and free-chlorine sampling activities.
 - viii. Record free-chlorine sampling data on log sheets, found in Appendix B, and send electronic copies of the sheets to EHS for recordkeeping and interpretation.
 - c. Housing Services:
 - i. Enter work orders or establish PMs with FMCS to conduct flushing and free-chlorine sampling in Housing buildings as needed.
 - ii. Assist FMCS in accessing areas necessary for flushing and sampling activities.
 - iii. Support FMCS in the performance of additional flushing or sampling activities based on results.
 - iv. Replace sink aerators and shower heads during major renovation activities.
-

6. Methodology

The procedures in this section outline water flushing, free-chlorine sampling, and associated activities.

Flushing procedures were created referencing the Environmental Science, Policy, and Research Institute's (ESPRI) guidance document, titled "Building Water Quality and Coronavirus: Flushing Guidance for Periods of Low or No Use."

Consult EHS at safety@andrew.cmu.edu for questions associated with these procedures or issues with sampling equipment.

7. Flushing Procedure

The water fixtures in a given building should be flushed starting where the water enters the building and then moving outward from there. Water should be flushed for a minimum of **two minutes** at each location, unless otherwise noted. All of the cold, water lines should be flushed first, followed by the hot, water lines.

If the building has zones, the water should be flushed zone-by-zone starting where the water enters the building. In each zone, starting with the zone closest to where the water enters the building and moving down the line from there, the cold water would be flushed first, followed by a flush of the hot water.

Note: When water flushing is requested in addition to free-chlorine sampling, the sampling must occur within one day of the flushing activities, and ideally immediately after on the same day. Where free-chlorine results are below the appropriate concentration, additional flushing should be conducted by FMCS immediately following sampling until the free-chlorine results raise above the appropriate concentration. If time does not permit additional flushing at the same time as sampling, the FMCS project manager should be notified so they are aware of the remaining flushing and sampling needs.

8. Sampling Procedure

Confirmatory sampling should be conducted by trained FMCS personnel using a portable colorimeter to determine the presence and concentration of free chlorine at water taps throughout applicable buildings. A Hach DR300 Pocket Colorimeter should be utilized for sampling, using 10 milliliter (mL) free chlorine reagent powder pillows. Additional materials that will be required for sampling include nitrile gloves, deionized water, AA batteries, and lint-free cloth.

See Appendix A for the full sampling procedure.

Note: when flushing is requested in addition to sampling, the sampling must occur within one day of the flushing activities, and ideally immediately after.

9. Sampling and Flushing Frequency and Building Selection

Free-chlorine sampling and water flushing frequency will occur periodically as listed in sections 6(c)(i)-6(c)(iii) below. Additional sampling may be conducted based on several factors, such as building occupancy, major construction activities, and season.

a. Housing

All Housing buildings used for student housing will be sampled for free chlorine once in the fall semester and once in the spring semester. An exception to this will be for apartment-style facilities that would require personnel to enter student-occupied living spaces to flush/sample, e.g. Roselawn Terrace—such locations will only be sampled either from water mains that can be accessed without entering the occupied living space when they are unoccupied.

During the summer term, both flushing and sampling will occur in all Housing buildings in early June and July.

Any Housing building that is unoccupied for 30 or more days will be flushed and sampled prior to being re-occupied.

b. Dining

Dining facilities located within Housing buildings will be sampled at the same frequency as those buildings.

Dining facilities located inside academic and administrative buildings will be included as an additional datapoint when main campus buildings are tested. Where there are multiple dining locations in one building, the least-used location will be selected for sampling.

c. Academic and Administrative Buildings

Free-chlorine sampling will occur monthly in selected academic and administrative buildings. Buildings with showers and those where free-chlorine results have been historically low will be prioritized for sampling.

10. Result Documentation

Free-chlorine results should be documented by FMCS personnel while conducting sampling. The free-chlorine sampling log found in Appendix A should be used to collect these results. Once completed, FMCS personnel should send the datasheets to EHS at safety@andrew.cmu.edu and the sampling requestor within one day of sampling.

11. Result Interpretation

Results should be compared to generally accepted industry standards¹— free chlorine concentrations should ideally remain above 0.5 milligrams per liter (mg/L) for water entering

¹ Association of Physical Plant Administrator (APPA)-sponsored webinar presented by Phigenics, “*Recommissioning Water Systems for Dormant Facilities and Infrastructure*,” Dr. Molly Scanlon, Phigenics

a building, but should be no lower than 0.2 mg/L, and remain above 0.2 mg/L in water at distal taps.

a. Water sources nearest to the water entry-point into a building

- i. Low: results are <0.5 mg/L and 0.2 mg/L
- ii. Borderline: results are <0.5 mg/L and >0.2 mg/L
- iii. Acceptable: results are >0.5 mg/L

b. Distal water sources

- i. Low: results are <0.2 mg/L
- ii. Acceptable: results are >0.2 mg/L

EHS will review results and provide recommendations for remedial actions as needed to FMCS and the sampling requestor. Remediation may include additional flushing and sampling, cleaning or replacement of fixture heads, etc. More frequent flushing and sampling may be recommended beyond the frequencies listed in section 6(c) based on observed trends in the data—long-term, seasonal, or other.

12. Training

Training on the flushing and free-chlorine sampling processes should be provided to FMCS and other affected personnel by EHS. Initial training is required prior to performing flushing and sampling activities and follow-up training will be provided as needed.

Contact EHS at safety@andrew.cmu.edu to request training.

13. Recordkeeping

Free-chlorine results will be forwarded to EHS after samples are collected by FMCS, see section 6(d). EHS will maintain these records and compile them for interpretation, tracking, and trending.

14. Equipment Selection and Maintenance

A Hach DR300 Pocket Colorimeter should be utilized for free-chlorine sampling using 10 milliliter (mL) free-chlorine reagent powder pillows. Additional materials needed for sampling include nitrile gloves, lint-free cloth, deionized water, and AA batteries.

For questions regarding equipment use or sampling materials, contact safety@andrew.cmu.edu.

15. Additional Methods Utilized to Reduce Risk of Bacterial Proliferation in Plumbing Systems

Although no environment is completely risk-free of bacterial growth in plumbing systems, a proactive approach to prevent potential illness associated with exposure to such bacteria is

Director of Standards, Compliance & Research, Michael Doyle, P.E., LEED AP, Phigenics Vice President of Operations, May 12, 2020

prudent. In addition to the water flushing and free-chlorine sampling procedures described in this guideline, CMU further reduces this risk through ongoing preventative maintenance efforts which help create plumbing environments that are unfavorable for bacterial growth. Such preventive efforts include:

- a. Performing preventative maintenance activities to verify water temperature set points are being maintained (120 degrees Fahrenheit).
- b. Support PWSAs annual hydrant flushing of PWSA-owned fire hydrants near to CMU buildings.
- c. Perform preventative maintenance activities to inspect and flush the private fire hydrants at the university.
- d. Continuous monitoring, testing and control for legionella within the chilled water system and associated cooling towers.
- e. Continue the implementation of the EHS's [Drinking Water Quality Program](#).

By documenting patterns and trends in the above processes, investigations can take place to address any potential underlying issues that may contribute to bacterial growth. At times, the solution to issues with water quality measurements may be as simple as flushing low-use areas or adjusting the thermostat on the water heater.

16. Revisions

Date	Documented Changes	Initials