Emergency Response and Drinking Water Safety

Emergency Disinfection of Small Water Systems

331-242 • Revised 11/13/2023

You should provide emergency disinfection when:

- Your water system loses pressure for any reason.
- You open up any part of your water system for maintenance or repairs.
- A cross-connection event occurs.
- Your water system is contaminated with coliform bacteria.

Before you disinfect, collect all required repeat and Groundwater Rule samples following an unsatisfactory routine result. If you're not sure how to proceed, contact our regional coliform staff. Any household bleach that is used to disinfect the water system needs to be free of any surfactants, deodorizers, scents, or other modifiers.

Notify Your Customers First

If you usually don't disinfect your water, notify all your customers first. Water with high chlorine levels can harm people with unique medical needs, such as kidney dialysis patients. All water systems should keep a list of people with unique medical needs. People with aquariums or fishponds also need to know before you chlorinate the water.

Disinfecting a Well

1. Use **Table 1** to calculate the volume of water in the well. You must know the total well depth and the static water level depth (water level when the pump is off). Subtract the static water depth from the total well depth to get the well's water depth.
2. Use **Table 2** (next page) to calculate how much chlorine to add to the well (see "Notes related to the tables" on page four).
3. Put the required amount of bleach into a five-gallon bucket of water. Pour the bucket of chlorine solution down the inside of the well.
4. Connect a garden hose **that has never been used** to the nearest outside faucet and circulate the water through the hose and back into the well. This will mix the chlorine with the water and the pump will draw the chlorine to the bottom of the well.
5. When you start to smell chlorine in the water coming out of the hose, use the hose to rinse the upper part of the well casing with disinfectant.

Table 1: Calculating Well Volume

Well Casing Diameter	Volume of Water per Vertical Foot
6 inches	1.5 gallons
8 inches	2.6 gallons
10 inches	4.1 gallons
12 inches	5.9 gallons
14 inches	8 gallons
16 inches	10 gallons
36 inches	53 gallons

Table 2: Chlorine bleach needed for well disinfection						
	Desired Dose Household-Strength 6% Bleach		Desired Dose Household-Strength 8.25% Bleach		Desired Dose Commercial-Strength 12% Bleach	
Well Volume	**5 mg/L**	**20 mg/L**	**5 mg/L**	**20 mg/L**	**5 mg/L**	**20 mg/L**
50 Gallons	1 Tbsp.	5 Tbsp.	1 Tbsp.	3 Tbsp.	½ Tbsp.	2 Tbsp.
100 Gallons	2 Tbsp.	9 Tbsp.	2 Tbsp.	6 Tbsp.	1 Tbsp.	4 Tbsp.
200 Gallons	4 Tbsp.	1 Cup	3 Tbsp.	¾ Cup	2 Tbsp.	9 Tbsp.
500 Gallons	11 Tbsp.	2 ¾ Cups	½ Cup	2 Cups	5 Tbsp.	1 ¼ Cups
1,000 Gallons	1 ¼ Cups	5 ¼ Cups	1 Cup	4 Cups	11 Tbsp.	2 ¾ Cups

Disinfecting Water in Pressure Tanks

You must disinfect the water in your pressure tanks, especially if you are responding to a coliform incident or other known contamination event. Drain the water from each tank and refill it with chlorinated water from your well or storage tank, which depends on your water system's layout. The chlorinated water should remain in the tank at least six hours (24 hours preferred). Drain or flush the chlorinated water from the tank and refill it with untreated water. Draining can affect air pressure, so you may need to recharge the air in pressure tanks.

Disinfecting a Storage Tank and Distribution System

If you must chlorinate your source and your storage tank, disinfect the source first.

1. If the contamination doesn't appear to be from the water source, you can add disinfectant just to the storage tank rather than the water source.
2. Use **Table 3** to determine the amount of chlorine needed to disinfect the storage tank. As a general rule:
   a. A chlorine dose of 1 to 2 mg/L is usually sufficient for a coliform incident or if you suspect contamination from pressure loss during a power outage.
   b. Larger chlorine doses may be required to address a bacteriological cross-connection event, flooding of water system facilities, or an *E. coli* MCL violation. Please consult with our regional office in these cases.

   See "Notes related to the tables" on page four. If you have an extensive distribution system, calculate the volume of water in the distribution piping and add it to the storage tank volume. Use that total volume in **Table 3** to determine how much chlorine to add to the storage tank.

   Table 4 shows common water distribution main sizes and volumes per foot of pipe. Estimate total length of water pipes in your water system and multiply the total by the appropriate value from the table. Use as-built drawings of the water system or a map to help estimate pipe diameters and lengths.
3. Draw down the water level in the storage tank, but keep enough for fire flow, if required.
4. As the tank refills, pour the chlorine in so it mixes.

Table 3: Chlorine Bleach Needed to Disinfect a Storage Tank									
	Desired Dose Household-Strength 6% Bleach			Desired Dose Household-Strength 8.25% Bleach			Desired Dose Commercial-Strength 12% Bleach		
Tank Volume (Gallons)	**1 mg/L**	**5 mg/L**	**10 mg/L**	**1 mg/L**	**5 mg/L**	**10 mg/L**	**1 mg/L**	**5 mg/L**	**10 mg/L**
5,000	1 ¼ Cups	6 ¾ Cups	13 ½ Cups	1 Cup	4 ¾ Cups	9 ¾ Cups	11 Tbsp.	3 ¼ Cups	6 ¾ Cups
10,000	2¾ Cups	13½ Cups	1 ¾ Gals.	2 Cups	9 ¾ Cups	1 ¼ Gal.	1 ¼ Cups	6 ¾ Cups	13 ½ Cups
20,000	5 ¼ Cups	1 ¾ Gals.	3 ½ Gals.	4 Cups	1 ¼ Gal.	2 ½ Gals.	2 ¾ Cups	13 ½ Cups	1 ½ Gals.
50,000	13 ½ Cups	4 ¼ Gals.	8 ¼ Gals.	9 ¾ Cups	3 Gals.	6 Gals.	6 ¾ Cups	2 Gals.	4 ¼ Gals.
100,000	1 ¾ Gals.	8 ¼ Gals.	16 ¾ Gals.	1 ¼ Gal.	6 Gals.	12 ¼ Gals.	13 ½ Cups	4 ¼ Gals.	8 ¼ Gals.

5. Use a blowoff, fire hydrant, or other outside faucet to draw chlorinated water from the tank into the distribution system. Then flush water from all faucets in the water system until you detect chlorinated water. You will probably smell the chlorine but, to be accurate, use a chlorine test kit to measure chlorine residual.
6. Allow the chlorine to remain in the water system at least six hours (24 hours preferred). It takes time for chlorine to disinfect effectively.
7. Replace the chlorinated water with chlorine-free water from your source by using outside faucets, blowoffs, or hydrants to draw water out of the water system. During this process, make sure you don't damage a pump by drawing water down below pump intake. Never discharge chlorinated water into any water body, wetland, or drainage ditch because it is extremely toxic to fish. You must dechlorinate the water prior to discharge. Depending on the chlorine levels in the water, you also may use normal water usage to replace the chlorinated water more slowly with chlorine-free water.
8. Wait at least seven days before collecting a coliform sample—or until you know there is no chlorine remaining in the water.* The coliform sample result will indicate whether disinfection was effective.

   If you are disinfecting in response to an *E. coli* MCL violation, work with staff from our regional office to determine when coliform sampling should occur relative to chlorination and flushing.

   When you collect a coliform sample, measure the chlorine residual and note the level on the lab slip. If you collect a coliform sample in follow-up to emergency disinfection, a measure of zero chlorine residual is worth noting on the lab slip.

**If you are using a chlorine residual test kit, and you can measure zero free chlorine residual throughout the water system sooner than seven days after the disinfection, you may collect coliform samples at that time.*

Disinfecting a Distribution System That has no Storage Tank

Some water systems use a well pump and pressure tank to provide water and have no storage tanks. If the volume of water in the distribution system exceeds the volume of water in the well, only partially disinfected water may reach parts of the distribution system when you attempt to bring chlorinated water from the well into the system.

Use **Table 4** to estimate the volume of water in your distribution system. After disinfecting the well and pressure tanks, draw chlorinated water into the farthest part of the distribution system (Step 5). Then immediately re-disinfect the well and draw chlorinated water into the distribution system closest to the well. Measure the chlorine residual with a chlorine residual test kit to make sure you have enough chlorine everywhere in the water system. Now follow steps 6 through 8.

Table 4: Estimated Volume of Water in the Distribution System

Pipe Diameter	Volume Per Linear Foot of Pipe	Volume Per 100 Feet of Pipe
1 Inch	0.04 Gallon	4 Gallons
2 Inches	0.16 Gallon	16 Gallons
4 Inches	0.65 Gallon	65 Gallons
6 Inches	1.47 Gallons	147 Gallons

For More Information

Contact our nearest regional office from 8 AM to 5 PM, Monday through Friday. If you have an after-hours emergency, call 877-481-4901.

Eastern Region, Spokane Valley 509-329-2100

Northwest Region, Kent 253-395-6750

Southwest Region, Tumwater 360-236-3030

Find more resources on our Publications and Forms webpage.

American Water Works Association (AWWA) references to help you disinfect water system facilities.

- AWWA Standard C654-13, "Disinfection of Wells"
- AWWA Standard C651-14, "Disinfecting Water Mains"
- AWWA Standard C652-11, "Disinfection of Water-Storage Facilities"

These AWWA standards assume the well, storage tank, or other component is isolated from the rest of the water system during disinfection. For that reason, AWWA cites much higher chlorine doses than those listed in this publication. Do not use high doses if there is a chance that any water system user could consume, or otherwise use, the water.

Notes Related to the Tables

Volumes calculated for Tables 2 and 3 have been rounded for your ease of use in the field. Use the equations below if a higher degree of accuracy is desired. Contact the Office of Drinking Water if in need of assistance.

Volume of bleach needed, $V_1 = (C_2 \times V_2) / C_1$, in gallons, where:

C_2 = desired chlorine dose, ppm

V_2 = the volume water to be treated, gallons

C_1 = the concentration of the bleach solution, ppm

To calculate the bleach required for volumes not in the tables

Add the volumes together (for 150 gallons, add the required bleach for 100 gallons to that needed for 50 gallons); or extrapolate between values on the table.

Well volume = $7.48 \times H \times 3.14 \times (D/12)^2 / 4$, in gallons, where:

H = the height of water standing in the well, in feet

D = the well casing diameter, in inches

6 percent bleach = 60,000 parts per million (ppm) hypochlorite

8.25 percent household bleach = 82,500 ppm hypochlorite

12 percent bleach = 120,000 ppm hypochlorite

1 cubic foot of water = 7.48 gallons

1 gallon = 16 cups

1 cup = 16 tablespoons or 8 fluid ounces

1 Tablespoon (Tbsp.) = ½ fluid ounce (14.8 mL)

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