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DOH 331-242
Revised

Emergency Disinfection of Small Water Systems

You should disinfect your water when:

- The water system loses pressure for any reason.
- Any part of the water system is "opened up" for maintenance or repairs.
- Backflow or backsiphonage creates a cross-connection event.
- The water system experiences an acute or nonacute total coliform MCL (maximum contaminant level) violation and an exact cause of the contamination has not been determined.

If you receive an unsatisfactory routine coliform sample result, collect the required repeat and Groundwater Rule samples before you disinfect. Contact our regional coliform staff if you're not sure how to proceed.

Notify your customers first

If you normally don't disinfect your water, notify **all** your customers first. Water with high levels of chlorine can seriously affect 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 depth of the well and the depth to the static water level (water level when the pump is off). Subtract the static water depth from the total depth of the well to get the depth of water in the well.
2. Use **Table 2** to calculate how much chlorine to add to the well (see "Notes related to the tables" on page 4).
3. Put the required amount bleach into a 5-gallon bucket of water. Pour the bucket of chlorine solution down the inside 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 8.25% bleach			**Desired dose Commercial-strength 12% bleach**		
Well Volume	***5 mg/L***	***20 mg/L***	***50 mg/L***	***5 mg/L***	***20 mg/L***	***50 mg/L***
50 gallons	1 Tbsp.	4 Tbsp.	½ Cup	½ Tbsp.	2 Tbsp.	5 Tbsp.
100 gallons	2 Tbsp.	½ Cup	1 Cup	1 Tbsp.	4 Tbsp.	¾ Cup
200 gallons	4 Tbsp.	1 Cup	2 Cups	2 Tbsp.	½ Cup	1¼ Tbsp.
500 gallons	½ Cup	2 Cups	5 Cups	5 Tbsp.	1¼ Cup	3 Cups
1,000 gallons	1 Cup	4 Cups	10 Cups	¾ Cup	2½ Cups	6 Cups

Disinfecting water in pressure tanks

You must disinfect the water in your pressure tanks, especially if you are responding to a coliform MCL violation or other known contamination event. You will need to drain the water from each tank and refill it with chlorinated water from your well or storage tank, depending on the layout of your water system. The chlorinated water should remain in the tanks for at least 6 hours (24 hours preferred). Drain or flush the chlorinated water from the tanks and then refill the tank with untreated water. Draining can affect air pressure, so you may need to recharge the air in your pressure tank.

Disinfecting a storage tank and distribution system

If you must chlorinate your source and your storage reservoir, 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. See "What chlorine dose is needed?" and "Notes related to the tables" on pages 3 and 4. If you have an extensive distribution system, calculate the volume of water in the distribution piping and add it to the volume of the storage tank. 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 the total length of water pipes in your water system and multiply the total by the appropriate value from the table. You can 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 to get some mixing.

Table 3: Chlorine bleach needed to disinfect a reservoir

Well Volume Gallons	Desired dose Household-strength 8.25% bleach			Desired dose Commercial-strength 12% bleach		
	1 mg/L	***5 mg/L***	***10 mg/L***	***1 mg/L***	***5 mg/L***	***10 mg/L***
5,000	1 Cup	5 Cups	10 Cups	½ Cup	3 Cups	7 Cups
10,000	2 Cups	10 Cups	1¼ Gals.	1¼ Cups	7 Cups	1 Gal.
20,000	4 Cups	1¼ Gals.	2 ½ Gals.	3 Cups	1 Gal.	1¾ Gals.
50,000	10 Cups	3¼ Gals.	6 Gals.	7 Cups	2¼ Gals.	4½ Gals.
100,000	1¼ Gals.	6 Gals.	12 Gals.	¾ Gals.	4½ Gals.	9 Gals.

5. Use a blowoff, fire hydrant, or other outside faucet to draw chlorinated water from the tank out into the distribution system. Then, flush water from all the faucets in the water system until you detect chlorinated water. You probably will smell the chlorine, but to be more accurate use a chlorine test kit to measure chlorine residual.

6. Allow the chlorine to remain in the water system at least 6 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 a pump intake. Never discharge chlorinated water into any water

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

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. You should 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 the disinfection was effective.

   If you are disinfecting in response to an acute total coliform MCL violation, you should 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 a 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.

For more information

If you have questions about disinfecting your water system, call our coliform or engineering staff at:

Eastern Region: Spokane Valley 509-329-2100

Northwest Region: Kent 253-395-6750

Southwest Region: Tumwater 360-236-3030

Our publications are online at https://fortress.wa.gov/doh/eh/dw/publications/publications.cfm

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

- AWWA Standard C654-13, “Disinfection of Wells”
- AWWA Standard C651-05, “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.

What chlorine dose is needed?

- A chlorine dose of 1 to 2 mg/L is sufficient for a nonacute MCL violation of the Total Coliform Rule or if you suspect contamination from pressure loss during a power outage
- Larger chlorine doses may be required to address a bacteriological cross-connection event, flooding of water system facilities, or an acute MCL violation. Please consult with our regional office in these cases.

Notes related to the tables

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 household bleach = 60,000 parts per million hypochlorite
12 percent bleach = 120,000 parts per million 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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