



# Disinfection of a Public Water System Well and Distribution System

*The following instructions are intended to assist small public water systems with the process of disinfecting their well and their distribution system.*

## Introduction

In accordance with Ohio Administrative Code (OAC) Rule 3745-9-08, all public water system wells are to be properly disinfected by chlorination before being placed into service or returned to service after completion of construction, installation, development, alteration, or repair. Unless the water system is equipped with a storage tank, disinfection of the distribution system will usually involve using the system's source (e.g., well) as the way to deliver chlorinated water to the distribution system. The following instructions incorporate the requirements of OAC Rule 3745-9-08 as well as additional information to assist small public water system owners and operators with disinfecting both their well and their distribution system. The procedure for disinfecting an artesian well is included at the end of this document.

## Procedure

1. It is recommended to remove all loose debris, sediment, mineral encrustation and bacterial slime from the well prior to disinfection. This can be done through physical and/or chemical cleaning. A state-registered well driller can assist with this process.
2. **Determine the type of disinfectant to add.** The calculations in these instructions apply to 6% unscented sodium hypochlorite (e.g., household bleach). Do not use bleach with fragrance additives. When using calcium hypochlorite tablets or granules, the tablets or granules shall be completely dissolved prior to placing them into the well.
3. **Calculate the amount of disinfectant (e.g., bleach) to add.** To disinfect the entire water system, you will need to determine the amount of disinfectant to add to the distribution system (see Step 1) and the well (see Step 2).

**Step 1. The Distribution System.** Calculate the volume of water in the distribution system. This includes the waterlines (i.e., pipes) and any tanks that hold water (e.g., pressure tanks, hot water heater).

**1a) Waterlines.** Calculate the water volume in the waterlines using Table 1. To do so, you will need to know the diameter of the waterlines throughout the distribution system and the approximate length of the pipes (see an example in Table 3).

**1b) Tanks.** Determine the amount of water held in any tanks in the distribution system (e.g., pressure tanks, hot water heater). The volume may be listed on the tank, or it can be looked up using the model number.

**Table 1. Water Volume in Waterlines**

Pipe Diameter (inches)	Water Volume (gallons per linear foot of pipe)
1/2	0.01
3/4	0.02
1	0.04
1.5	0.09
2	0.16
4	0.65
6	1.47

**1c) Combine the volumes to get a total volume.** Combine the volume of the waterlines and the tanks to determine the total volume of water in the distribution system.

**1d) Multiply the total distribution system volume by 0.001.** To determine how much bleach to add for the distribution system, use a ratio of 1 gallon of bleach (6% sodium hypochlorite) for every 1,000 gallons of water. This should provide a chlorine concentration of 60 mg/L. To factor in this ratio, multiply the total volume of water in the distribution system by 0.001. The result will be the amount of bleach needed, in gallons, for the distribution system.

# Disinfection of Public Water System Wells

**Step 2. The Well.** The disinfectant concentration in the well shall initially be at least 100 mg/L chlorine. Table 2 can be used to determine the amount of bleach necessary.

**Table 2. Amount of Bleach (6% Sodium Hypochlorite) Needed**

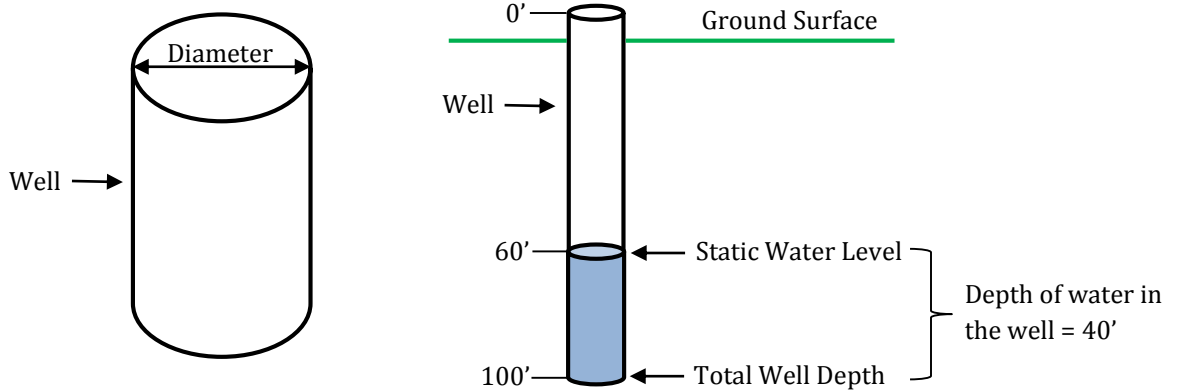
Well Diameter (inches)	Depth of Water in the Well <sup>1</sup>					
	1-50 ft.	51-100 ft.	101-150 ft.	151-200 ft.	201-250 ft.	251-300 ft.
4	1 cup	2 cups	3 cups	3.5 cups	4.5 cups	1.5 quarts
4.5	1 cup	2.5 cups	3.5 cups	4.5 cups	1.5 quarts	0.5 gal.
5	1.5 cups	3 cups	4 cups	1.5 quarts	0.5 gal.	0.5 gal.
6	2 cups	4 cups	1.5 quarts	0.5 gal.	2.5 quarts	3 quarts
7	3 cups	1.5 quarts	0.5 gal.	3 quarts	1 gal.	1 gal.
8	3.5 cups	0.5 gal.	3 quarts	1 gal.	1 gal.	1.5 gal.
9	1.5 quarts	0.5 gal.	1 gal.	1 gal.	1.5 gal.	1.75 gal.
10	1.5 quarts	3 quarts	1 gal.	1.5 gal.	1.75 gal.	2 gal.
11	0.5 gal.	3 quarts	1.25 gal.	1.75 gal.	2 gal.	2.5 gal.
12	0.5 gal.	1 gal.	1.5 gal.	2 gal.	2.5 gal.	3 gal.

The depth of water in the well can be determined using the well log and the following formula:

$$^1\text{Depth of water in the well} = \text{Total well depth} - \text{Static water level}$$

The **well log** is a record of the construction, depth, and geologic material encountered in the well. Well logs can be searched for here: <https://apps.ohiodnr.gov/water/maptechs/wellogs/appNew/Default.aspx>

**If the static water level or total well depth are unknown, contact the Ohio EPA District Office for assistance.**



**Step 3. The entire system.** Combine the amount of disinfectant needed for the distribution system (from Step 1) and for the well (from Step 2) to get the total amount of disinfectant needed for the entire system.

# Disinfection of Public Water System Wells

**EXAMPLE:**

ABC Diner has a well and one building.

**Step 1: The distribution system.** The distribution system includes approximately 100 feet of 1-inch pipe extending from the well to the building. The building includes a bathroom, a kitchen, and a mop sink with approximately 75 feet of 3/4" pipe. There is also a 75-gallon hot water heater and a 30-gallon pressure tank. See Table 3 for calculations. The volume of bleach needed for the distribution system is 0.11-gallons.

**Table 3. Example Distribution System Calculations for ABC Diner**

	Component	Formula	Volume (gal.)
<b>Waterlines</b>	100 feet of 1-inch pipe	$100 \times 0.04 \text{ gal/foot}^1$	4
	75 feet of 3/4-inch pipe	$75 \times 0.02 \text{ gal/foot}^1$	1.5
<b>Tanks</b>	Hot water heater	N/A (Printed on tank)	75
	Pressure tank	N/A (Printed on tank)	30
<b>Total Water Volume in the Distribution System:</b>		$4+1.5+75+30$	110.5
<b>Amount of Bleach Needed for the Distribution System:</b>		$110.5 \times 0.001$	<b>0.11-gal (or 1.75 cups)</b>

**Step 2: The well.** The well is 6-inches in diameter. According to the well log, the static water depth is 60' and the total well depth is 100'. Therefore, the depth of water in the well =  $100' - 60' = 40 \text{ feet}$  of water in the well. Using Table 2, a 6-inch diameter well with 40 feet of water would need 2 cups of bleach (6% sodium hypochlorite).

**Step 3: The entire system.**

$$\begin{aligned}
 \text{Amount of bleach needed for the distribution system} &= 0.11\text{-gal (or 1.75 cups)} \\
 \text{Amount of bleach needed for the well} &= + 2 \text{ cups} \\
 \text{Total amount of bleach needed for the entire system} &= 3.75 \text{ cups}
 \end{aligned}$$

4. It is recommended to mix the bleach with water prior to pouring it down the well to ensure there is enough disinfectant available to adequately disinfect the well and its components. For example, fill a new 5-gallon bucket (or a clean one reserved for this purpose) halfway with water and add the necessary amount of bleach.
5. **Remove the well cap and add the chlorine solution to the well.** Slowly pour the disinfectant into the well by wetting the inside casing walls, drop pipe, and electrical cable.
6. **Agitate or surge the water in the well.** Water in the well must be agitated or surged to ensure even distribution of the disinfectant throughout the entire water column. Recirculating water back into the well casing from an outside spigot may distribute chlorine throughout the water column if the well pump is located at the bottom of the well. To do so:
  - a. Run a food grade hose from a nearby spigot directly into the well. A food grade hose looks similar to a garden hose, but meets ANSI/NSF Standard 61 for drinking water system components.
  - b. To circulate water through the well, turn on the spigot for approximately 15-30 minutes from the time you smell chlorine from the food grade hose.
  - c. During this process, debris can slough off the sides of the well casing and iron and manganese deposits can begin to form. If you notice a significant amount of debris or discoloration in the water during the agitation/surging process, you can pull the hose out of the well and run it to waste until there is a decrease in the amount of debris and/or discoloration. If this occurs, you may need to repeat steps 4 through 6 by adding more bleach solution and repeating the agitation/surging process. Never discharge chlorinated water into any water body, wetland, or drainage ditch because it is extremely toxic to fish.
7. **Disinfect the distribution system.** Go to the furthest tap (faucet, spigot, etc.) in the distribution system and turn on the tap until a chlorine odor is detected. Shut off the tap and move to the next furthest tap and repeat the process. Continue this process at each tap at your facility. If you provide hot water, you must turn on both the hot water and cold water taps in order to disinfect both waterlines. Anywhere the water is piped must be disinfected.

## Disinfection of Public Water System Wells

- a. It is recommended to check the chlorine residual at the taps during the process to ensure the free chlorine residual does not go below 50 mg/L (e.g., use a chlorine residual test kit). If the free chlorine residual drops below 50 mg/L, add more bleach to the well to ensure the distribution system is thoroughly disinfected.
8. **Cap the well and allow it to stand without pumping for at least eight hours (preferably 24 hours).**
  9. **If the system is being disinfected for the seasonal start-up procedure, proceed as follows. Otherwise, proceed to Step 10 below.**
    - a. **Flush the system.** After disinfection, flush the chlorine out of the entire system. To do so, turn on the waterlines for a minimum of 15 minutes. Non-chlorinated systems shall remove free chlorine to a non-detectable level. Chlorinated systems shall have chlorine levels of at least 0.2 mg/L (free) or 1.0 mg/L (total) and less than 4.0 mg/L (total).
    - b. The system has been disinfected and flushed. Proceed to the next steps in the “Seasonal Public Water System Start-Up Requirements and Checklist.” These include verifying that the treatment system is operating properly (if applicable), collecting the special purpose total coliform sample(s) from the distribution system, and submitting the “Annual Start-Up Certification” form.
  10. **If the system is being disinfected for any other reason:**
    - a. **Flush the system.** After disinfection, a well shall be flushed for a minimum of 15 minutes and total chlorine shall be undetectable before sampling for total coliform.
    - b. **Collect total coliform samples.** The well may be placed into service when 2 consecutive samples collected from the well at least 30 minutes apart are total coliform negative. Microbiological and total chlorine samples shall be analyzed in accordance with OAC Chapter 3745-89 and Rule 3745-81-27.
    - c. **Proceed as follows based on the total coliform sample results:**
      - i. **At least one sample is positive (“unsafe”).** If any of the bacterial samples taken from the well in step 10b are reported as total coliform positive, then do one of the following:
        1. Repeat steps 10a and 10b by thoroughly flushing the well, then collecting 2 additional samples at least 30 minutes apart; or
        2. Repeat steps 4 through 10. If either total coliform sample is still positive (“unsafe”) after a second chlorination, contact the Ohio EPA district office.
      - ii. **Both samples are negative (“safe”).** The well may be placed back into service.

### Procedure for Disinfecting a Flowing Artesian Well

Flowing artesian wells generally do not require disinfection. If a flowing well is testing positive for bacteria, the following protocol may be used to disinfect the well:

Chlorine should be applied at or below the lowest aquifer formation producing the artesian condition in an amount that will produce a chlorine concentration of at least 25 mg/L in the flowing water. The chlorine may be introduced through a weighted tube discharging a solution with a high concentration of chlorine (such as 15,000 mg/L) or using calcium hypochlorite tablets confined in a perforated container.

### Contact

For more information, contact your inspector in the appropriate District Office:

**Northwest:** 419-352-8461

**Northeast:** 330-963-1200

**Central:** 614-728-3778

**Southwest:** 937-285-6357

**Southeast:** 740-385-8501