The Complete Guide to Home Chlorination Systems

How to Choose and Set-up Your Home Chlorinator

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Chlorination Systems for Well & Spring Water

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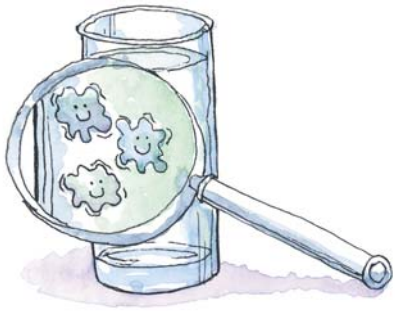
Clean Water Made Easy.

Water used for drinking and cooking should be free of odor, slime producing bacteria, and pathogenic (disease causing) microorganisms that cause such illnesses as typhoid fever, dysentery, cholera, and gastroenteritis.



Although several methods eliminate microorganisms and odors in water, chlorination is the most commonly used. Chlorination is effective against many pathogenic and non-pathogenic bacteria, but at normal dosage rates it does not kill all viruses, cysts, or worms. Often combined with filtration, chlorination is an excellent and cost-effective way to disinfect drinking water supplies, eliminate odors, and oxidize iron, and other metals.

Liquid Chlorinator

The two most common methods of chlorination for residential well water systems are:

- Chlorine bleach (sodium hypochlorite)
- Solid bleach pellets and powders (calcium hypochlorite)

Questions to Ask When Choosing a Chlorinator:

- Have I had my water tested?
- What is the "chlorine demand" (based on my water test) of my water?
- What is the flow rate of my well pump in gallons per minute?
- How much contact time do I have after the chlorine is injected and will a contact tank be necessary?
- What is the line pressure in PSI, at the point where I plan to inject the chlorine?

In-Line Solid Chlorine Pellet Feeder

Pellet feeder mounted on top of well. Drops chlorine pellets when well pump runs

Test Your Water

A general mineral analysis will provide a list of the common minerals. Important items to test for include:

- Coliform bacteria
- Alkalinity
- pH
- Hardness (calcium carbonate)
- Iron
- Manganese
- Total dissolved solids

Stains and Odors

If water is discolored, or has a strong odor, you may also want to test for:

- Iron Bacteria
- Tannin
- Hydrogen sulfide

Water test kit with tests that can be used on-site for immediate results. A mail-in sample bottle is available to send to lab for additional tests.

Professional Analysis or Home Test Kit?

If you are trying to eliminate iron, manganese or odors, home test kits you can use yourself on-site can work very well. The EPA recommends testing your water annually for coliform bacteria and nitrate.

To find a local lab, consult your county health department for recommendations.

The water sample should be drawn as close to the source as possible, before any filtration systems.

Allow water to run for 5 to 10 minutes, to make sure you are getting a sample that is coming directly out of the well, and has not been sitting in pipes or pressure tanks.

Laboratory analysis water test kit. Contains freeze pack with special bottles for sending by overnight UPS or FedEx to the lab. Extensive analysis for bacteria, general minerals, metals and chemicals are available at a relatively low cost.

Estimate Chlorine Demand

When chlorine is added to water it not only reacts with bacteria, but also with other impurities, such as hydrogen sulfide, soluble metals, particles of organic matter and other microorganisms. The chlorine demand must first be satisfied, before a residual chlorine concentration can be established.

Once there is a residual chlorine concentration, it must be maintained during the required contact time to kill pathogenic microorganisms. To adequately disinfect the water it is therefore required to supply the water with a higher chlorine concentration than the concentration required to kill bacteria.

Chlorine demand is simply how much available or "free" chlorine in mg/L or PPM is needed to kill bacteria, remove odor, and/or oxidize iron, in order to achieve your goals.

Amount of chlorine required to kill bacteria and oxidize iron, manganese and hydrogen sulfide:

Contaminant	Amount of free-chlorine in mg/L	Estimated contact time required if pH is 6.0 to 7.5 Temp @ 10C*
Bacteria	2.0	6 to 10 minutes
Iron 1 mg/L	0.6 to 1.0	2 to 6 minutes
Manganese 1 mg/L	1.7 to 2.0	2 to 6 minutes
Hydrogen Sulfide 1 mg/L	2.0 to 3.0	2 to 6 minutes

* Based on CT Values recommended by USEPA. CT value is Concentration of chlorine multiplied by Time in retention. C x T = CT value. The less Concentration of chlorine you have, the longer the contact Time required.

Example: Common well water analysis and chlorine demand calculation:

Contaminant	Concentration	Multiplier		Total
Coliform	Present	x 2	=	2.0
Iron	2.0 mg/L	x 1	=	2.0
Manganese	0.2 mg/L	x 2	=	0.4
Hydrogen Sulfide	2.0 mg/L	X 3	=	6.0
	Total Applied Chlorine Dose			10.4 mg/L

Note, calculations for Chlorine Demand do not have to be exact. Once the system is up and running, a simple free-chlorine test after your contact tank will let you know your chlorine demand. The chlorinator can be then be easily adjusted to put out more or less chlorine as needed.

pH:

Chlorine is most effective if the water has a pH in the range of 6.0—7.5. At pH 8.0 much more chlorine is required to have the same effect than if the water had a pH of 7.0. At pH over 8.5 chlorine becomes more ineffective as a disinfectant .

Temperature:

The warmer the water, the more effective free-chlorine is in disinfecting water and oxidizing iron. Colder water less than 10C (50F) requires longer contact times and higher concentrations of chlorine than examples shown.

CT Values:

CT values have been set by USEPA and WHO guidelines to show how much Concentration of chlorine and the Time that is required to inactivate bacteria and viruses. C x T = CT. See page 11 for more information.

Determine Your Well Pump Flow Rate

Your well pump can pump water up to a certain maximum flow rate in gallons per minute. For example, say you could fill a 5 gallon bucket in 1 minute. This is a flow rate of 5 gallons per minute or 5 GPM. If the water filled up a 5 gallon bucket in 30 seconds, the flow rate would 10 GPM. Knowing how many gallons per minute your water system can pump is critical to picking the right type of water treatment system, and it is easy to determine.

All you need is a 1 or 5 gallon bucket and a watch or clock. It takes just a few minutes:

1. Open any hose bib or faucet until pump turns on.
2. Close hose bib or faucet and let pump fill up pressure tank until it turns off.
3. Using a 1 or 5 gallon bucket, open faucet and collect and measure all water discharged until pump turns on.
4. When pump turns on, immediately close faucet and start timing pump cycle*
5. When pump turns off, record pump cycle time to refill pressure tank in seconds.
6. Divide the number of gallons collected in Step 3 by the number of seconds in Step 5.
7. Multiply the answer from Step 6 by 60.
8. The answer in Step 7 is the average pumping capacity of the pump in gallons per minute (GPM).

Click this link to our online calculator to make your calculations more quickly and easily:
http://www.cleanwaterstore.com/technical/water-treatment-calculations/body_flow_rate.html

Systems with Variable Speed "Continuous Pressure Pumps"
Note that some well pumps are known as "continuous pressure pumps;" they don't turn on at one pressure and off at another. These types of pumps are "variable speed," meaning that they run slow at first, and then faster as the pressure drops in the pipes. For continuous pressure systems, you need to consult with the pump installer or look at the pump's documentation to see what your flow rate is.

Perform a '"Toilet Tank Inspection"

Unless your toilet tank is new or has recently been cleaned, your toilet flush tank can be a wealth of useful water quality information! Simply lift the cover and look in. If you see rust stains or rust deposits this can indicate iron pipe corrosion or there may be iron naturally occurring in your well water. A toilet tank check combined with a water analysis gives you a good idea of what is occurring in your pipes and fixtures.

Determine Contact Tank Size Required

Whether you are injecting chlorine with a liquid bleach chlorinator using a metering pump, or using a solid chlorine pellet feeder, you need a certain amount of contact time after the chlorine has been injected for the chlorine to work properly.

Well Water Flow Rate in GPM X Contact Time in Minutes = Contact Tank Size in Gallon

For example, your well pump is pumping at 10 gallons per minute ("GPM"), and you have coliform bacteria and want 10 minutes of contact time.

10 GPM x 10 minutes = 100 Gallons

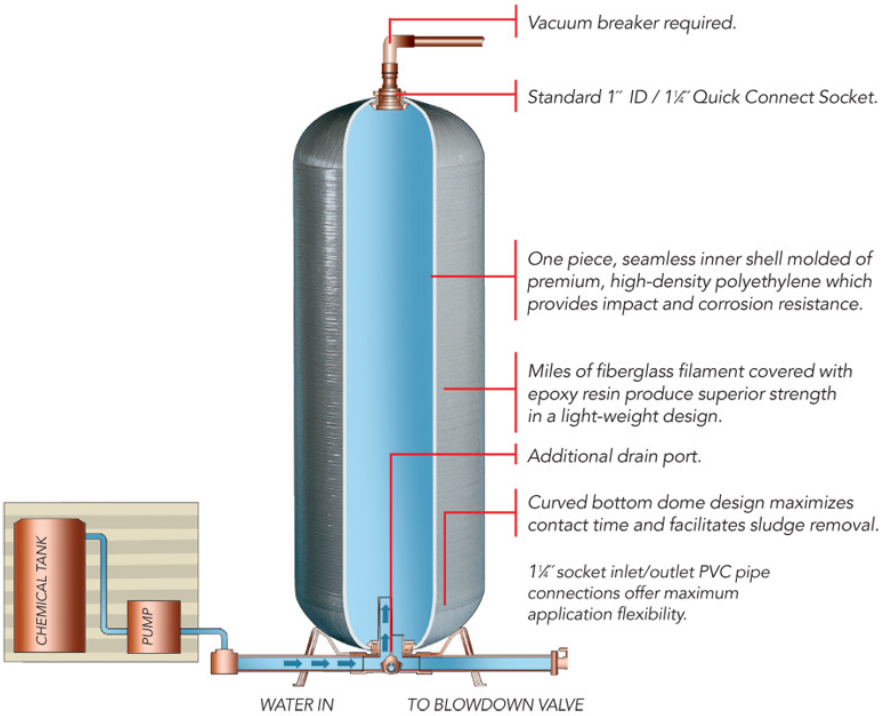
So therefore you would want a contact tank that held at least 100 gallons of water.

The best contact tanks are like a large pipe, the water enters at one end and flows out the other end.

Typical home well water chlorination and pH adjustment system with 80 gallon contact tank.

Homeowner-installed Proportional-Feed Chlorinator. Flow sensor (black middle device) senses rate of flow and allows metering pump to pump more or less chlorine based on the flow of water.

Well-Mate Brand Contact retention tank. Usually installed after pressure tank.



Homeowner-installed standard chlorinator. This one is wired to turn on and off with a flow switch (not shown)

Metering Pumps—Liquid Chlorine Feeders

Metering pumps are used to inject a small amount of chlorine (sodium hypochlorite solution, or calcium hypochlorite solution) into the water, usually in conjunction with a contact tank. The pumps draw chlorine bleach from a solution tank and pump it into a pipe under pressure.

If you know your line pressure you can determine if the pump are you are selecting is suitable for your pressure. Most metering pumps can handle up to 125 PSI, which is more than enough for most home well systems.

Metering pumps are rated by how much solution they can pump, and come in various sizes. A common size for chlorination for most home well water systems is a pump that can pump .1 to 1.0 gallon per hour. The pump has two adjustments, one for speed and one for stroke, so it can be adjusted to deliver the precise amount you need.

A degassing valve on these pumps make it ideal for use with chlorine bleach and ensure the pump will not lose its prime.

Chlorine Solution Tank with Metering Pump

Typical Home Chlorination System. Chlorine is injected prior to the pressure tank. Each time the well turns on, the chlorine pump turns on and injects a tiny amount of chlorine bleach into the water. The water then flows through the contact tank, where it has time for the odors, bacteria and iron to be oxidized. It then flows through the iron filter, and a backwashing carbon filter. The result is clean, clear, odor-free, disinfected, chlorine-free water throughout the home.

Contact tank (provides time for chlorine to work)

Chlorine pump

Chlorine bleach solution tank

Carbon Backwash Filter (removes chlorine residual)

Iron Filter (with Pro-OX or Greensand filter media)

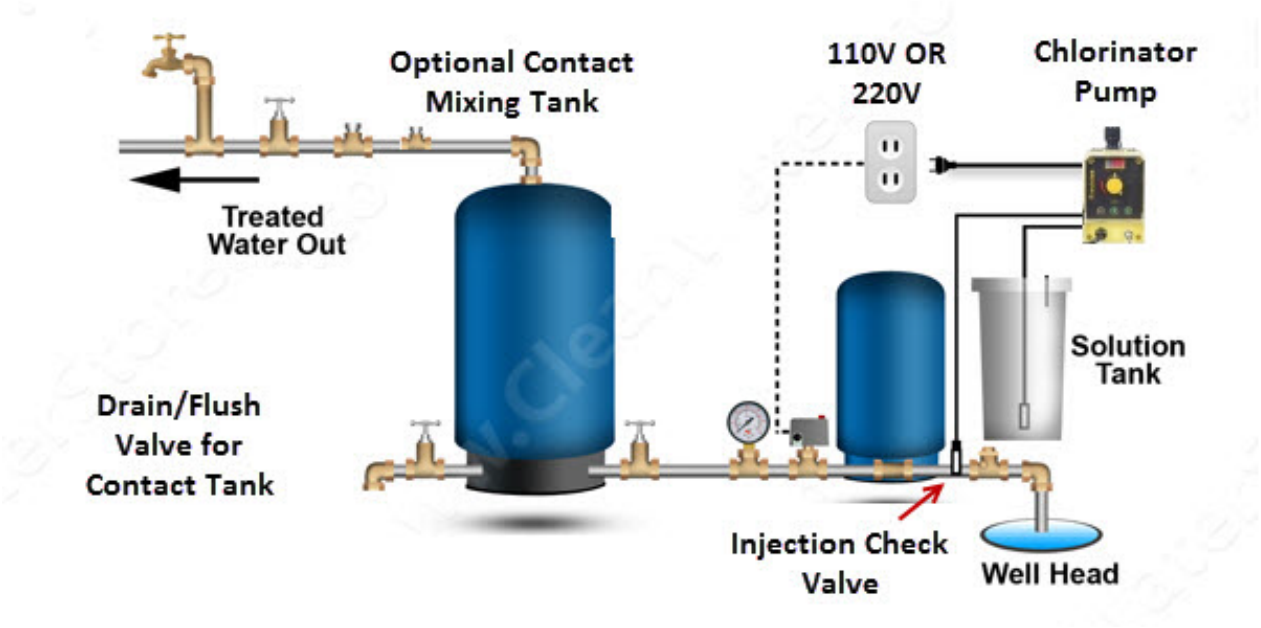
Three ways to turn the chlorinator pump on and off:

Chlorinator metering pumps need to be installed so they turn on and off automatically. There are three methods commonly used:

1. Wire to turn on and of with the well pump pressure switch
2. Use a flow switch
3. Use a proportional-feed flow meter

OPTION 1:

By Well Pressure Switch: In this type of installation, the metering pump is plugged into a dedicated electrical outlet that is wired in to the pressure switch. When the pressure switch points close, the chlorine solution pump is turned on. This a reliable and low cost option. An electrician may be needed to comply with local codes and/or if you are unfamiliar with basic wiring.



Next: Pre-Wired Flow Switch Option

Three ways to turn the chlorinator pump on and off (continued)

OPTION 2: PRE-WIRED FLOW SWITCH

An easy alternative to installing a dedicated outlet and wiring to the pressure switch is to use a pre-wired flow switch. The flow switch cord is plugged into any 120V wall outlet, and the chlorinator pump is plugged into the outlet that is built in to the flow switch.

Whenever there is flow, the chlorinator pump is energized and starts to pump. Easy to wire, just plug in, turn on. Available in 110v or 220v.

A flow switch can be installed in the pipe before the pressure tank so that each time the well turns on (and there is water flowing) the electrical outlet on the flow switch will turn the chlorinator pump.

Next: Proportional Feed Flow Meter Option

Three ways to turn the chlorinator pump on and off (continued)

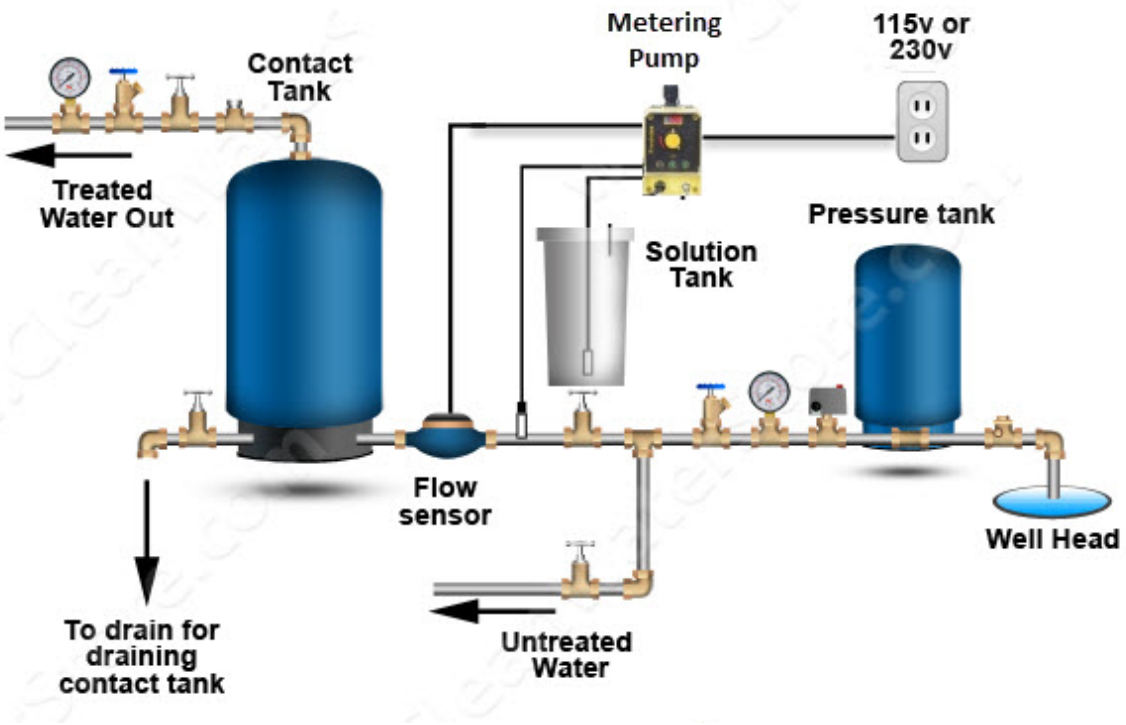
OPTION 3: PROPORTIONAL FEED FLOW METER

In some applications the chlorine injection point must be after the pressure tank, such as when the pressure tank and well are away from the house and it is impractical to have the chlorine being injected before the pressure tank.

In this case, a Proportional-Feed system can be used. Based on how fast the water is flowing, more or less chlorine is pumped into the water to maintain a precise residual.

Like the flow switch, it is easy to install, and allows installation of your chlorination system anywhere after the well pressure tank.

Whenever there is flow, the chlorinator pump is energized and starts to pump. Easy to wire, just plug in, turn on. Available in 110v or 220v.



Two Methods to Set up Contact Tanks

1. Water enters in at bottom, exits at top of tank. This method is the most common and is useful for settling sand and sediment out in the contact tank. A simple ball valve at the bottom allows one to drain and flush the tank of accumulated iron and sediment.

- Best for most applications
- Provides contact time for disinfection
- Tank easily drained

2. Water enters in at bottom, exits at bottom. This method is useful when there are air or gasses in the water. Water travels up center tube and then back down through the water. Any gasses or air present accumulate at the top and are vented off by the air vent.

- Best for applications where gasses are present in the well water
- Provides contact time
- Vents off gasses
- Air compressor (optional) can be installed for increased aeration and de-gassing

How to Determine Chlorine Solution Strength and Metering Pump Size

Step 1: Determine flow rate of the water stream you are injecting into, in Gallons Per Minute (GPM) or Liters Per Minute (LPM).

Step 2: Determine the parts per million of chlorine you are trying to achieve (PPM). This is the chlorine residual based on estimated chlorine demand.

Step 3: Use the formula below to compute the gallons per day and select your pump. Pumps are sized by gallons output every 24 hours (gallons per day).

Step 4: Adjust the output of the metering pump to achieve proper dosage.

Formula: Multiply the Flow Rate (in gallons per minute) times the Applied Dosage in Parts Per Million Desired times 1440. Then divide by the Solution Strength being used. (Flow Rate GPM X Chlorine PPM x 1440)/Solution Strength in PPM.

Example Formula : Assume that you have a well pump that has a flow rate of 12 gallons per minute (12 GPM) and that you want to inject 3.0 ppm of chlorine into the water.

You have decided to use a solution strength of 25,000 ppm or 1 gallon of 5% bleach to one gallon of purified or at least softened water.

There are 1440 minutes in a 24 hour period, and the formula will tell you how many gallons of chlorine you will use for every 24 hours the well pump runs.

The formula is:
(12 GPM x 3.0 PPM x 1440)/25,000 = 2.07 Gal. Per Day

This means that you need a metering pump that has an output of 2.0 gallons per day. Chlorinator pumps (also known as metering pumps) can be adjusted to easily meet the output you need.

Your well pump might run for 1 hour a day, so at this rate you would use 2.0 gallons of your chlorine bleach solution every 24 hours the pump runs. It is better to add more solution every one to two months as the solution can lose its potency over time.

Whatever your initial setting, be sure to test for total and free-chlorine and then adjust the pump and/or the solution strength to achieve your desired free-chlorine residual in your piping.

Liquid chlorine bleach (sodium hypochlorite):

- Easy to use and mix
- Mixes and dilutes rapidly
- Use certified chlorine for drinking water , or make your own liquid bleach with NSF certified dry powdered bleach.
- Lower cost than dry chlorine
- Needs to be kept away from sun and heat
- Decays rapidly, use within 1 to 3 months for best results.

Pool bleach or commercial grade chlorine bleach is typically 10% to 12% chlorine, or 100,000 PPM to 120,000 PPM.

Household bleach is not for potable water systems; it may contain contaminants such as benzene.

Dry chlorine bleach (calcium hypochlorite)

NOTE: If you cannot find 'certified bleach' that is specifically for drinking water, you can use powdered NSF certified bleach, and make your own liquid bleach. This is widely available.

Solid Pellet Chlorinators:

In-Line or Well-Mount Pellet Feeder

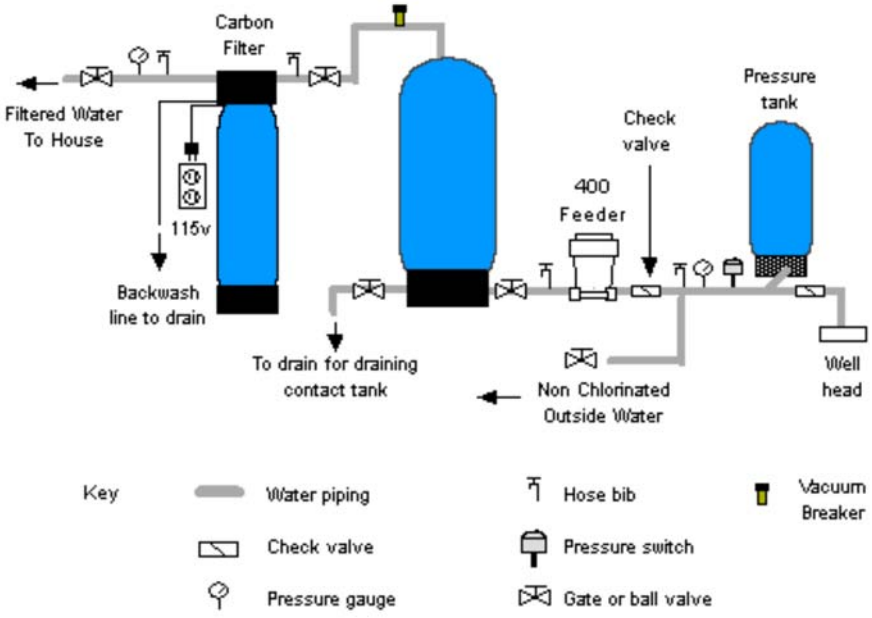
Calcium hypochlorite is used in solid pellet chlorinators. Calcium hypo is 65% chlorine and a very strong oxidizer.

The **Model 400 In-Line chlorinator** will operate on varying pressure such as a home well system or on constant pressure such as a sprinkler or pool system. The chlorinator is adjustable, but the exact dose cannot be controlled as easily as the liquid chlorinators using a metering pump. Often the minimum adjustment allows a chlorine residual of 3—5 ppm to enter the water, so a contact tank and a carbon filter are recommended after the system, especially if used for residential applications.

In-Line Feeders are installed on the pipe after the pressure tank:

- No electrical power required
- Easy to fill and re-fill
- Easy to install and adjust
- Heavy iron may foul the pellet feeder
- Very hard water may cause feeder to clog with calcium build-up

Typical installation where the in-line solid pellet chlorinator is installed after the pressure tank and before the contact tank.



Well-mount chlorine pellet drop systems drop pellets down the well automatically when the well pump runs.

Well-Head Pellet Feeders:

- Mounts on top of well
- Easy to fill and re-fill
- Easy to install and adjust
- Uses well as contact tank
- May help well resist fouling from iron bacteria slime.
- Excess pellet feeding may cause damage to well pumps

CT Values

- The CT Value is the Concentration multiplied by the contact or retention Time.
- Higher concentrations of chlorine are needed if the contact time is short. A longer contact time is desirable.
- A 3 log removal means 99.9% removal rate. A 4.0 log removal rate is 99.99%.
- The higher the temperature, the less contact time is required.
- Past pH of 7.0, higher concentrations of chlorine are needed as pH increases

***CT* Values for Inactivation of Viruses by Free Chlorine**

Log Inactivation						
	2.0-log		**3.0-log**		**4.0-log**	
Temperature, °C	**pH6-8**	**pH 8-10**	**pH 6-8**	**pH 8-10**	**pH 6-8**	**pH 8-10**
0.5	6	45	9	66	12	90
5	4	30	6	44	8	60
10	3	22	4	33	6	45
15	2	15	3	22	4	30
20	1	11	2	16	3	22
25	1	7	1	11	2	15
Note: *CT* values can be adjusted to other temperatures by doubling the *CT* for each 10°C drop in temperature.						

Example:

The well water temperature is 50°F or 10°C. We want a 4.0 log reduction of viruses. Our pH is 7.0. Therefore the applicable CT value is 4. We have want to inject 1.0 ppm of chlorine and have a contact time of 4 minutes in order to achieve our CT value.

For home water systems where there is no operator constantly watching over the system and checking water quality, we recommend a doubling of these figures, so 1 .0 ppm of chlorine and 8 minutes of contact time is typically recommended.

Other contaminants in the water such as iron, manganese, turbidity, tannin, organic matter, ammonia and sediment can all have an effect on the amount of chlorine required and contact time. If there is a chance that pathogenic organisms are present, it is better to err on the side of caution and use a higher CT value.

Chlorination Systems for Well Water

CHEAT SHEET

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1. Do The Basics

- ☐ Test Water Chemistry
- ☐ Check Well Water Flow Rate
- ☐ Estimate Chlorine Demand
- ☐ Determine Contact Tank Size
- ☐ Note line pressure where chlorine will be injected into

2. Choose Chlorinator

- ☐ Liquid chlorinator or dry pellet feeder? (Choose liquid for more precise control over dosage)
- ☐ Where to install chlorinator, before pressure tank or after pressure tank?

3. Installation

- ☐ Buy Direct + Install Yourself OR
- ☐ Buy Direct + Hire a Plumber for Installation OR
- ☐ Buy from Water Treatment Dealer

4. Quality Control

- ☐ Set up Maintenance Schedule +
- ☐ Clipboard with Check List
- ☐ Test Well Water Annually

Questions? Email us at info@cleanwaterstore.com or call toll-free 888-600-5426 or 831-462-8500