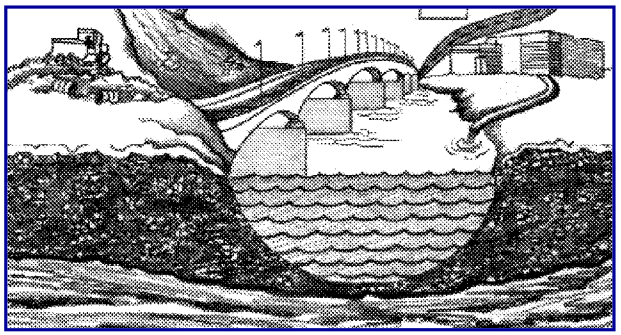
HOW-TO BOOKLET #3404

WATER QUALITY

TOOL & MATERIAL CHECKLIST

- ❑ Lead/Water Test Kit
- ❑ Chlorine Feeder
- ❑ Solid Block Carbon Filter
- ❑ Distiller
- ❑ Sediment Filter
- ❑ Saddle Bracket and Clips
- ❑ Nitrate/Water Test Kit
- ❑ Granulated Carbon Filter
- ❑ Reverse Osmosis (RO) Filter
- ❑ Water Softener
- ❑ Ultraviolet Lamp



Read This Entire How-To Booklet for Specific Tools and Materials Not Noted in the Basics Listed Above.

Water quality is a very fragile thing. Only a small amount of certain contaminants can greatly affect a large volume of water. Here are some examples:

- One drop of oil can make up to 60 gallons of water undrinkable.
- One drop of common organic herbicide can contaminate 26 million gallons of drinking water.
- One gram of lead makes 260,000 gallons of water unfit for drinking.
- One gram of cancer-causing PCBs (polychlorinated biphenyls) can make more than one billion gallons uninhabitable for fresh water aquatic life.

WATER SOURCES

There are two main sources of our drinking water. Surface water is one source found in lakes, ponds, rivers, streams, and reservoirs. The other source is groundwater. This is percolated water naturally stored in aquifers, which are large underground areas of rock and soil saturated with water. The nation's water is supplied about equally between the two sources, although most drinking water in rural areas comes from groundwater.

Delivery of Drinking Water. The type of water delivery system you rely on depends on where you live. In most rural areas each home supports its own well and waste disposal system. A typical rural home's potable water is pumped from an aquifer into a pressure tank. The daily water needs of the household are pulled directly from that pressure tank. When water is drawn from the tank, the well pump automatically comes on and restores the pressure and volume in the tank. Short of the electricity required to operate a well pump, a rural home's water supply is completely self-contained.

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Towns and cities acquire water in a variety of ways. Where underground water is plentiful, a number of deep wells might be used in conjunction with storage facilities. Lacking sufficient quantities of underground water, many municipalities pump from nearby rivers or run-off collection reservoirs. A few are completely reliant on water pumped in from neighboring districts. Once collected and treated, city water is pumped through water mains and pressurized by pumps to supply home service. In some cases, the ratio of dissolved mineral salts (such as iron and manganese) is altered to suit taste and to protect pipes, valves and appliances.

If your water is supplied by a utility, it is monitored, treated and filtered to check disease-carrying organisms and other suspended impurities. If you have your own well, monitoring the water quality is your responsibility.

WATER CONTAMINANTS

Contaminants in drinking water come from a variety of sources **(Fig. 1)**. Contaminants may include naturally occurring substances, natural and industrial radioactive chemicals, and synthetic chemicals from industrial processes and agriculture. A number of compounds which some people consider contaminants (such as chlorine) may be added during the process of treating water. Substances such as lead and copper may enter the water from the pipes used in the water distribution system itself.

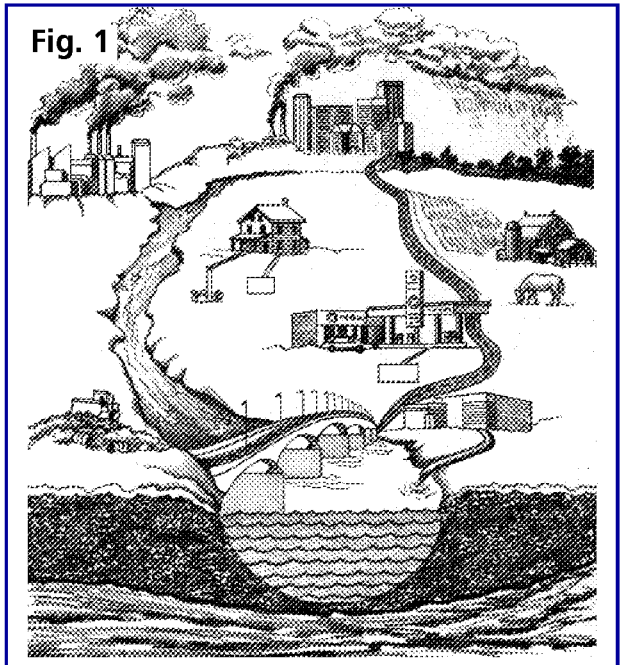
People contaminate water with many of the products we use daily. Solvents, cleansers and pesticides contribute to the contamination of our water. Many municipalities pump treated or semi-treated sewage back into water supplies. A septic system that is located too close to a well or is malfunctioning is another source of water contamination.

The Environmental Protection Agency requires municipal water supplies to be tested for over 80 pollutants. If they don't find them, the system operators can say that their water system is safe. (There are also some pollutants that municipalities are not required to test for.) Of all the chemicals and metal contaminants in water, those most hazardous to our health are lead and nitrates (a fertilizer by-product).

Lead in Water. Too much lead in the human body can cause serious damage to the brain, kidneys, nervous system, and red blood cells. Young children and pregnant women are at the greatest risk, even with short-term exposure. Lead levels in your drinking water are likely to be highest if:

- Your home or water system has lead pipes.
- Your home has faucets or fittings made of brass, which contains some lead.
- Your home has copper pipes with lead solder, and is less than five years old and has naturally soft water.
- Water sits in the pipes for several hours.

Fig. 1



Sources of Water Pollution Include:

Toxic Pollutants	Industrial Waste
Sewage/Septic Tanks	Acid Rain
Polluted Wells	Pesticides & Fertilizers
Hazardous Waste Dumps	Underground Gas Tanks

Any time the water in a faucet has not been used for six hours or longer, flush the cold-water pipes by running the water until it becomes as cold as it will get. (This could take as little as five to thirty seconds if there has been recent heavy water use from showering or toilet flushing. Otherwise, it could take two minutes or longer.) The more time water has been sitting in your home's pipes, the more lead it may contain.

Use only water from the cold-water tap for drinking, cooking, and especially for making baby formula. Hot water is more likely to contain higher levels of lead.

Testing for Lead. To be certain your water doesn't contain lead, have it tested. This can be done by a competent laboratory, or by using a do-it-yourself test kit available at home centers. Your water supplier, EPA, or county health agent can offer information or assistance with testing.

Apartment dwellers shouldn't overlook having their water tested. Flushing may not be effective in high-rise buildings with lead-soldered central piping. **Note:** If your water supply system is free of lead there's no need to waste water by running it to clear the possibility of lead deposits.

Nitrates in Water. Nitrates in the drinking water may be extremely harmful to babies less than one year old. In some babies, nitrates react with the hemoglobin in their blood to produce a rare and dangerous form of anemia known as "blue baby syndrome" (methemoglobinemia). This can lead to brain damage or death. Nitrate-contaminated water must not be given to babies in a bottle or used to make baby formula. Breast-feeding mothers should not drink it, because nitrates can pass into breast milk.

In people of all ages nitrates can also be converted to cancer-causing chemicals known as nitrosamines. Some scientific research has found a link between nitrosamines and stomach cancer and non-Hodgkin's lymphoma.

Use a reliable laboratory to test your water for

nitrates. Ask the lab for a copy of the sampling procedures and instructions. People living in rural, agricultural, and forested areas need to be especially concerned about nitrogen in fertilizers. Many lending institutions now require testing for nitrogen and possible pesticide contamination as part of real estate transactions in which the home uses water from a private well.

Other Sources of Water Pollutants. Other minerals—iron, manganese, sodium, and cadmium—may be in unacceptably high concentrations in water. If you are a well owner, and your house has elevated indoor radon levels, test your well water for radon. Radon in your water supply can increase your indoor radon level, although this is a small health risk compared to radon entering from the soil (see How-To Booklet #3402 for complete information on radon).

Harmful bacteria may also be found in water. It is usually only a concern of people with a private well system, however. These organisms commonly originate from human or animal waste that has infiltrated groundwater from septic tank drainage, feedlot manure, etc. The EPA recommends testing for total coliform and E. coli bacteria. Among the diseases caused by high levels of bacteria: gastroenteritis, infections, dysentery, hepatitis, typhoid fever, cholera.

In municipal water systems, the bacteria problem is usually solved by chlorination. For private well water, a chlorine feeder in tandem with an activated carbon filter can disinfect water from a questionable source.

Other problems include hydrogen sulfide, which produces a rotten-egg smell, and carbonic acid, which turns copper fixtures green. Small amounts of these materials can be removed by softeners and filters. To remove large amounts, special equipment is necessary.

HOME WATER-TREATMENT SYSTEMS

Have your water tested to learn whether you need a water treatment system in your home. Ask municipal officials which tests are commonly done in your area.

Home water treatment is generally done with filters. There are four primary types of filters sold in home centers and plumbing supply stores: granulated activated carbon; solid carbon block; reverse osmosis (RO); and distillation systems.

The chart below shows the contaminants each will remove.

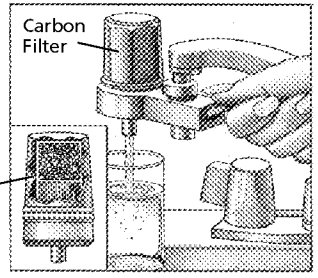
OBJECTIONABLE CONTAMINANTS	Granular Carbon	Solid Carbon Block	Reverse Osmosis	Distillation
Asbestos	some	✔	✔	✔
Bacteria		some	✔	✔
Inorganic Chemicals (e.g.- arsenic, cadmium, lead mercury, selenium)		some	some	✔
Synthetic Organic Chemicals (e.g.- pesticides, PCBs, solvents)	✔	✔	✔	
Nitrates			✔	✔
Odor	✔	✔	some	some
Radon	some (gas only)	some (gas only)	some (particles only)	some (particles only)
Sodium			✔	✔

Granulated Activated Carbon. The granulated activated carbon (GAC) filter operates by the principle of absorption. Particle contaminants are attracted to the tremendously porous structure of the carbon granules.

Carbon filters come in two varieties, high volume and low volume. The high volume models are installed in supply lines. Low volume models are usually used as dedicated tap filters.

Fig. 2

A tap-installed, low-volume GAC filter. Requires carbon filter replacement.



There are two types of low-volume units. Activated charcoal filters, like the one shown in **Figure 2**, represent the most common and inexpensive units available. They require frequent filter replacement to maintain efficiency. Installing a charcoal filter can be as simple as screwing the unit into the spout of the kitchen sink, or as complex as tying a floor-mounted tank into the pressure tank of a private well system. Cartridges on spout-attached units must be changed every few months.

Some low-volume GAC filters tie into the cold water faucet supply by means of a self-piercing saddle tap **(Fig. 3)**, similar to those used for refrigerator ice-makers. The filter is mounted on a wall bracket and the top saddle is bolted to a cold water supply pipe. With the compression connections made, the self-piercing tap is screwed into the pipe and backed out again. The tap is installed in the fourth hole of the sink. This style GAC has an expiration date indicating when to replace the filter.

As shown in **Figure 4**, a high-volume GAC filter can be installed on either a horizontal supply line or a vertical one. In either a vertical or horizontal supply line installation the filter must remain in a vertical position. If your piping is made of copper or plastic, installation will require cutting the line and splicing in valves and male adapters. (Some

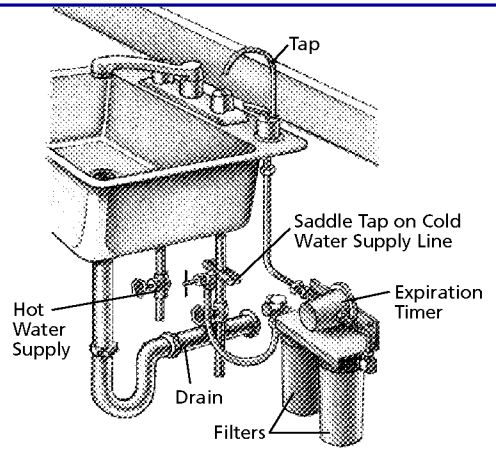


Fig. 3

A low-volume GAC installation tied into the cold water line.

filters have built-in stops and compression fittings.) Just cut the line and install a full-flow valve at each cut. Then thread a male adapter into each end of the filter, using Teflon tape.

If you have a vertical line, use four 90-degree ells to make the offset. For a horizontal line, just connect short pieces of pipe between the new valves and the filter. If you are using copper sweat fittings, you'll have to solder the male adapter to the pipes before installing them to avoid scorching the filter housing. Never use lead solder for this. If your piping is made of galvanized steel, you'll have to disassemble the most accessible line to its nearest fittings and reassemble it with unions and nipples.

Solid Carbon Block. The activated carbon filter material in this unit is compressed into a solid block. It's more expensive than the granulated type, but, as can be seen on the chart, it has a more effective filtering action range. The filter unit is installed in basically the same manner as the high-volume GAC unit. Like the GAC element, this filter loses its effectiveness over time, and will need periodic replacement.

Reverse Osmosis. This unit combines a cellophane-like reverse osmosis membrane and an activated charcoal filter to trap most contaminants in water systems. The membrane filters out heavy metals. The filter traps organic chemicals, pesticides, radon particles (not gas), and odor **(Fig. 5)**. The RO unit also contains a sediment filter and a large tank to store the filtered water. Reverse osmosis filtering is a slow process taking as much as 3 to 6 hours to process one gallon of clean drinking water.

Distillation System. A distillation water treatment system does not filter the water **(Fig. 6)**. The unit boils the water. The steam is then condensed by a coil and the impurity-free water collects in a storage tank, where it is drawn off by the faucet. The distillation process is slow, taking up to 5 hours to process one gallon of water.

There are two models generally available. Free-standing units are usually placed in the basement or utility room. Countertop units require no direct hookup to your tap. Instead you pour the day's water requirement into it. With either distiller, the distilled water must be drained from the unit's storage tank and chilled in the refrigerator for drinking.

Other Water Treatment Systems. There are other filtration systems with more narrowly defined roles:

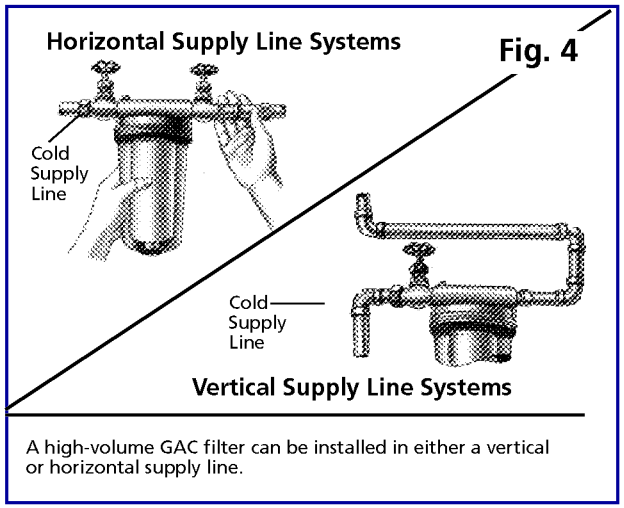


Fig. 4

A high-volume GAC filter can be installed in either a vertical or horizontal supply line.

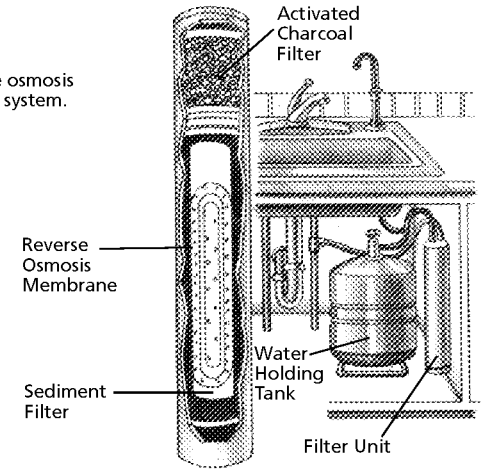


Fig. 5

A reverse osmosis filtration system.

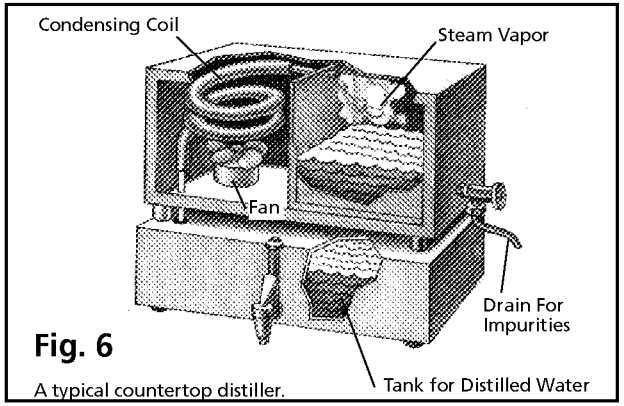


Fig. 6

A typical countertop distiller.

- Ultraviolet lamps. These provide ultraviolet radiation and are effective against bacteria. They are primarily used in private or well-water systems.
- Ion-exchange systems (or water softeners). These systems are effective if water has a heavy concentration of calcium, magnesium and/or iron. The phrase usually used to describe this kind of water is "hard water," but it does not fall into the "contaminated" category. To find out if your home has a hard water problem, draw off a pint of tap water into a bottle you can cap, add 10 drops of detergent, and shake well. If the solution foams readily, your water is relatively soft. If you get a curd-like film instead of foam, invest in a water softener or ion-exchange system.
- Sediment filters. These filters are composed of a cellulose element that strains out sediment, silt, and cloudiness. In a two-stage unit, a neutralizing or sediment filter is combined with an activated carbon filter.
- Some well water systems have a third ceramic filter element effective in reducing cysts such as giardia lambia and cryptosporidium (microorganisms that cause severe flu-like symptoms). Often these drinking water systems incorporate an ultraviolet light that kills various other harmful microorganisms.