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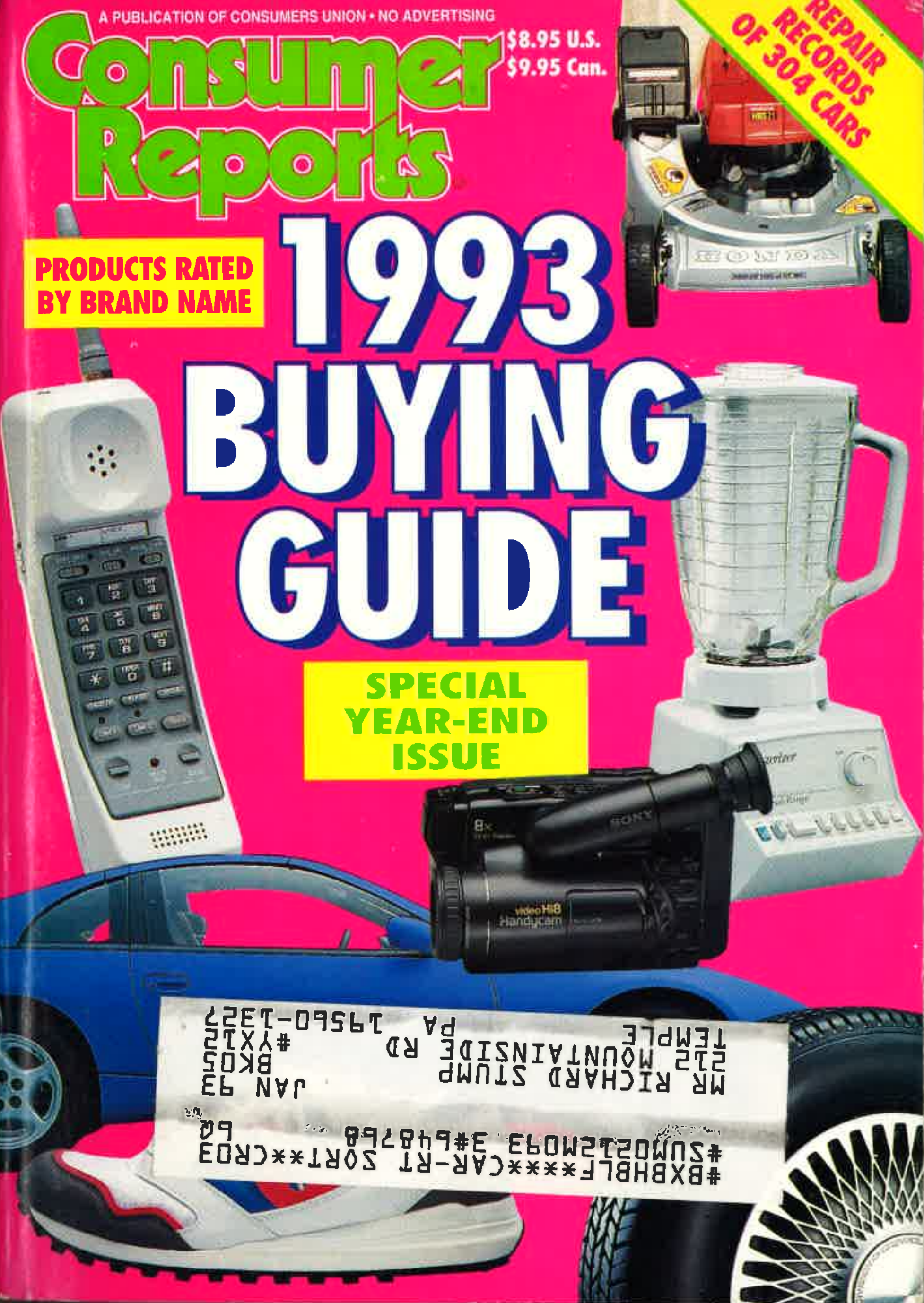

HEPA filter. You can expect to spend $30 to $120 for HEPA filters a year; other types will use $20 to $80 a year.

Most air cleaners require little maintenance beyond filter changes and cleanings. If you choose an electrostatic precipitator you'll need to wash its electronic cell every few months. When the air cleaner makes a crackling sound, you'll know it's time to clean it.

WATER TREATMENT

Despite all the scary news reports, most people's drinking water in the U.S. is not seriously polluted. Public supplies are either comparatively clean to start with or are purified to bring them up to par. Some people who sell water filters and other treatment devices, though, hope you don't know that. The less you know, the more easily they can sell you equipment you may not need.

What gives high-pressure or deceitful tactics an air of credibility is that there are some very real drinking water problems. More than 70,000 water contaminants—industrial and agricultural wastes, heavy metals, radon, and microbes—have been identified. While such contaminants may affect only a fraction of the population, those people have justified concerns.

If you're wondering about your water quality, the first step is to find out what's in the water. If you use a community water system, ask for your utility's latest laboratory test results. If you use a well, try to get information on local water problems from your public works department or the local agricultural extension service.

Testing your water

The surest way to know what's in your water is to test it. The *Nordic Ware Water Test Kit*, about $8 at a hardware store, lets you run a few basic water-quality tests at home. It's easy to use and accurate enough for home use. For an extra $6, the *Nordic Ware* kit offers a mail-in test for lead, a useful option. Unfortunately the kit cannot detect most toxic pollutants. If you suspect you have a problem with, say, organic solvents or pesticides, you need to have your water tested by a professional.

If you have your water tested by someone else, use a reputable, state-certified, independent laboratory, not a company that sells water-treatment equipment. Tests cost from $20 to $200, depending on their complexity. (For more information about selecting a lab, see page 199.) If a test report says your water has a high level of a contaminant, seek confirmation by having the water retested or sent to a second lab before taking costly action.

Pollutants to worry about

Of the thousands of water pollutants, three of the most widespread are lead, radon, and nitrate. Most organic pollutants present only localized problems. Treatment methods are listed in the chart on page 198.

Lead. Significant levels of this toxic metal are more widespread in drinking water than was once assumed, and levels once considered safe are now considered health concerns, particularly for infants and children. Even low-level lead exposure may affect learning ability in children and is associated with elevated blood pressure in adults.

Lead gets in water primarily from corrosion of plumbing. Very soft water, which is more corrosive than hard water, is especially likely to leach lead from soldered pipes and brass fixtures. To help minimize your exposure, use only cold water for cooking and drinking (hot water will dissolve more lead). More important, before drinking, run water for a minute or so to flush the pipes.

If a test reveals that water from flushed pipes contains more than 15 ppb of lead, you may want to install a treatment device. See below for a discussion of devices.

Radon. A naturally occurring radioactive gas, radon probably poses a greater health risk than all other environmental pollutants combined. According to the EPA, radon may cause between 10,000 and 40,000 lung-cancer deaths each year. Most of the risk comes from radon that seeps into homes from the ground. But some well water contains dissolved radon, which escapes into the air in the home from sources like showers and washing machines. Exposure to radon from water may cause between 100 and 1800 deaths a year.

Water-borne radon is usually confined to wells in private or small community water systems. Larger systems generally remove any radon before it reaches the tap. Before you test your water for radon, test the air inside your house. If the level is high and you use ground (well) water, have the water tested. If the air level is low, don't worry about the water.

The level that should prompt remedial action is a matter of dispute. According to an EPA official, you should take action if the water's radon level is 10,000 picocuries per liter or higher (that corresponds to about 1 picocurie per cubic meter of airborne radon). Radon is easily dispersed in outdoor air, so aerating the water before it enters the house is often the simplest solution. Ventilating the bathroom, laundry, or kitchen may also help dissipate the radon. Other solutions include carbon filters (see next column).

Nitrate. High nitrate levels in water pose a risk mainly to infants. Bacteria in their digestive tracts convert it into nitrite, which in turn combines with hemoglobin in the blood to form methemoglobin, which cannot transport oxygen. The resulting ailment, called methemoglobinemia, is rare, but can result in brain damage or death. Some adults, including pregnant women, may also be susceptible to developing methemoglobinemia.

Nitrate in water comes mainly from agricultural activities. Rural families with private wells—especially those with infants or pregnant women—should have their water tested regularly. Some state health departments test wells for free. High nitrate levels may signal that other contaminants are also present.

Treatment choices

If tests show your water supply is contaminated, you can buy bottled water; CU's tests have shown that it's generally pretty clean. If you have a well, you might also try digging deeper to an uncontaminated aquifer. Or you can treat your existing water supply with one of several types of a water treatment device:

Carbon filters. These treat a variety of problems, so they're the most popular water-treatment device. They remove residual chlorine, which improves the water's taste, and can also remove organic compounds—chemicals such as pesticides, solvents, or chloroform. But they won't remove hardness minerals, most heavy metals, or microbes (under certain conditions, they actually breed them).

Carbon filters come in many forms. High-volume filters—in-line filters for about $100—serve a single cold-water faucet. Tiny, faucet-mounted filters with a couple of ounces of carbon cost $20 to $30. Pour-through or pitcher devices cost a few dollars. Whole-house carbon filters ($1500 and up), which have five-foot-high tanks and can be backwashed, are especially useful

for removing radon from the whole house's water.

The most practical are in-line filters that treat water at a single location, such as at the kitchen sink. The two main designs are under-sink models and countertop models, which attach with flexible tubes.

Filters and cartridges have to be periodically replaced, at costs ranging from $5 to $100 each time. Manufacturers typically recommend replacing a filter after a certain time or after a given quantity of water has passed through. Some filters have a water meter built in. For a high-volume in-line filter, expect to change cartridges every six months or 1000 gallons.

Reverse-osmosis devices. Reverse-osmosis devices are best at removing inorganic contaminants, such as dissolved salts, ferrous iron, chloride, fluoride, nitrate, and heavy metals such as lead. A carbon filter is incorporated in most reverse-osmosis systems to remove organic chemicals.

But reverse-osmosis devices can be clogged by high levels of hardness minerals. They work slowly, producing only a few gallons of fresh water per day, and they waste several gallons of water for every purified gallon they produce.

At the heart of these devices lies a fine sieve of rolled-up cellophanelike material—a semipermeable membrane that screens out all but the smallest molecules. Under pressure, only water and other small molecules are able to pass through.

Some versions attach to the cold-water line under the sink; others sit on the counter. Under-sink models run $500 to $850, countertop models about $350 to $500.

Filters and membranes need replacement about once every few years. Replacement membranes cost $45 to $234, filters another $25 or so.

Distillers. Distillers boil water, then cool the steam until it condenses. Some models include a tiny carbon filter. Countertop units hold from one-half to 2½ gallons. Prices range from $150 to $429.

Distillers are best for brackish water or water polluted with heavy metals; they demineralize it. Anything that won't boil or evaporate stays behind in the boiling pot. Boiling water can also kill microorganisms, but distillers shouldn't be relied on for that purpose. Distillers aren't effective against volatile organics like chloroform and benzene, which vaporize in the distiller and can wind up in the condensed water. A carbon filter might help remove such chemicals, but the filters incorporated into distillers are too small to do it reliably. Distillers are slow, taking a couple of hours to produce the first quart of water.

Since distillers collect and concentrate minerals, scale can build up quickly and must be cleaned out. And since they heat up, they use a lot of electricity—something like three kilowatt-hours per gallon of water they purify.

Water softeners. Water softeners remove minerals that cause soap deposits, and also remove iron and lead. They don't remove hazardous contaminants like radon, nitrate, or pesticides. They also take a lot of space. A water softener consists of a tank of tiny resin beads loosely coated with sodium ions. When hard water flows in, minerals—principally calcium and magnesium—take sodium's place on the resin. Periodically the softener reverses its flow, taking salt out of a reservoir tank to regenerate the resin beads. The minerals are flushed down the drain.

Some models regenerate at preset intervals, using a timer. More sophisticated models ("demand-control" models) regenerate according to water use. Softeners also differ in size. "Cabinet" units are the most compact.

The average price for a softener is about $1000, but the price varies depending on installation, local water conditions, and dealers that are competitive.

A water softener doesn't require very much care, except for the salt you add now and then. You can adjust the level of salt consumption. A high setting ensures softer water but means more frequent refills. A lower setting saves salt and money, but the resin may regenerate less completely.

Iron removers. Dissolved iron in water can leave rusty brown stains in the bathtub and sink. You can use a water softener to remove the iron, but special-purpose treatments are available for water where hardness is not a problem. An iron remover uses an oxidizing agent to precipitate the iron out. One common design is a canister similar to a water softener. Iron removers cost anywhere from $400 to $650, and are best for removing clear ferrous iron. They can be noisy at times.

Activated alumina lead-removal cartridges. These install on cold-water lines in a standard water-filter housing. If lead is your only problem, this is an effective solution. The cartridges cost about $100, the housing $50.

The tests

Tests were geared to the type of device being tested.

We tested the carbon filters using water spiked with chloroform, one of the most common organic compounds found in drinking water. Chloroform, a possible carcinogen, can often be traced to chemical reactions between dissolved organic matter and the chlorine used to disinfect public water supplies. The water we used contained 1 part per million chloroform, 10 times the maximum permitted by the U.S. Environmental Protection Agency.

We tested the reverse-osmosis devices using water laden with 600 parts per million of sodium chloride (a representative dissolved solid), and 2 to 10 times the Government's allowable limits for lead, cadmium, copper, and barium. We also measured the removal of calcium, a hardness mineral present in moderate amounts in our local supply.

To challenge the filters further, we pumped our test water at an average of 45 pounds per square inch (psi), close to the minimum operating pressure needed for a reverse-osmosis system.

For our primary tests of distillers, we used water spiked with phenol, a chemical related to benzene and typical of a large class of volatile organics. We spiked the water with 0.5 parts per million phenol, a dangerously high level of contamination for related organic compounds.

We also used each unit to distill 50 batches of mineral-laden water. That test showed, in effect, how well the distillers would work with hard water. It also functioned as an endurance test of sorts. We cleaned the units only occasionally, then let them sit uncleaned for a few weeks to see what would happen to their innards.

For the water softeners, we concocted very hard water. We measured the time needed to flush brine through the resin to restore a unit's softening capability and the amount of water used in regeneration for each 1000 gallons of water softened.

For all the devices, we evaluated ease of installation and use.

Buying advice

The chart on page 198 sums up treatment methods recommended for the most common water problems. Before doing business with an unfamiliar water-treatment company, call the Better Business Bureau or a local consumer-protection agency to find out if there are unresolved complaints against it.

If you're looking at carbon filters, the more carbon the better. Based on our tests, small pour-through filters and fist-sized units that thread onto the faucet can im-

prove the taste of water, but are simply too small to remove hazardous chemicals. High-volume under-the-sink or countertop filters do a much better job. Look for those with replaceable filter cartridges. Cartridges made either with a "carbon block" or granulated carbon are better than those with powdered carbon.

If your carbon filter has a built-in sediment filter and your water contains a lot of undissolved solids, the sediment part may clog before the carbon is used up. To extend the filter's life, install a separate sediment prefilter upstream of the carbon. A 5- to 10-micron mesh is fine enough. A clear plastic sump on the filter housing will let you see when the cartridge needs changing.

If you're considering a distiller, look at how easy it is to fill or clean. We found little variation in how well distillers removed inorganic compounds.

Any water softener will do an acceptable job of removing minerals, according to our tests. For greatest efficiency and minimum salt consumption where water use varies from week to week, a demand-control model is best.

For iron removal, costlier models have the advantage of removing more iron and regenerating automatically rather than manually. They're designed for high iron levels. Aeration devices can also precipitate and remove iron and also radon.

For removing lead, the least troublesome device is an activated alumina lead-removal cartridge installed on a cold-water line. You could also use a distiller or reverse-osmosis device, but they're needlessly slow if lead is your only water problem.

Water problems and solutions

Recommended if drinking water contains more than "action level" amounts.

	Action level	Carbon filter	Reverse osmosis	Distiller	Water softener	Iron remover	Activated alumina cartridge	Sediment filter	Aerator
AESTHETIC PROBLEMS									
Dissolved iron	—				✔	✔			
Rust stains	—			✔		✔		✔	
Calcium	—				✔				
Magnesium	—				✔				
Chlorine	—	✔							✔
Salty taste	—		✔	✔					
'Skunky' taste	—	✔							
Total dissolved solids (TDS)	500 ppm		✔	✔					
HEALTH HAZARDS - Organic									
Benzene	5 ppb	✔							✔
Carbon tetrachloride	5 ppb	✔							✔
Lindane	4 ppb	✔		✔					
Methoxychlor	100 ppb	✔		✔					
Trichloroethylene	5 ppb	✔							✔
Trihalomethanes (THM)	100 ppb	✔							
HEALTH HAZARDS - Inorganic									
Arsenic	50 ppb		✔	✔					
Barium	1 ppm		✔	✔	✔				
Cadmium	10 ppb		✔	✔	✔				
Chromium	5 ppb		✔	✔	✔				
Fluoride	4 ppm		✔	✔			✔		
Lead	15 ppb		✔	✔			✔		
Mercury	2 ppb	✔	✔	✔					
Nitrate	10 ppm		✔	✔					
Selenium	10 ppb		✔	✔			✔		
HEALTH HAZARDS - Radiological									
Dissolved radon	10, 000 pc/l	✔							✔

MAIL-ORDER WATER-TESTING LABS

Companies that sell water-treatment equipment often offer a free or low-cost water analysis as part of the sales effort. Don't depend on that kind of test. It's like asking a barber if you need a haircut. Consult an independent, state-certified lab instead. You can often find one in the Yellow Pages under "Laboratories—Testing."

Or use a mail-order lab. We've identified three reliable ones to date: National Testing Laboratories (6555 Wilson Mills Rd., Cleveland, Ohio 44143; telephone 800-458-3330); Suburban Water Testing Laboratories (4600 Kutztown Rd., Temple, Pa. 19560; telephone 800-433-6595); and Clean Water Fund (29½ Page Ave., Asheville, N.C. 28801; telephone 704-251-0518).

The labs send you a kit containing collection bottles and detailed instructions. You collect water samples and ship them back by overnight package delivery. The labs provide test results and an explanation of the numbers two to three weeks later.

National charges $29 for a lead test. A 73-item scan for minerals, bacteria, and volatile organics costs $89; and a 93-item test that includes pesticides costs $129. A radon test costs $29. Suburban charges $25 for lead, $50 for radon, and $135 to test for 40 items, including bacteria and volatile organics. Clean Water Fund is a nonprofit organization and research project; its tests are for lead in water, paint, soil, dust, and ceramics. Each test costs $12.