



Lead & Copper in Drinking Water

POCKET GUIDE

EMSL ANALYTICAL, INC.
TESTING LABS • PRODUCTS • TRAINING

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History of Lead (Pb)

For thousands of years, lead has been mined, smelted, and used by mankind. The Romans used lead extensively in their aqueducts, pipes, cookware, cosmetics, and other items. Some historians have even blamed its use for the decline of the empire due to the effects of lead poisoning.

Lead poisoning is also one of the first recognized environmental hazards. While it was believed to be poisonous by some ancient civilizations, lead was still used extensively throughout the years. It wasn't until the last several decades that the use of lead in paints and as an additive to gasoline was banned in the United States.

The use of lead in pipes, solder, and plumbing fixtures was also the norm for centuries. In fact, lead water pipes were widely used up until the early 20th century. Lead water pipes are still in use in many communities where they can pose, in some circumstances, an exposure risk to people that consume tap water that has become tainted with lead.

In more recent times, concerns over lead contamination in water in Flint, Michigan made national headlines. Due to a change in the city's water source and insufficient water treatment, lead leached into the water supply from old lead pipes impacting over 100,000 residents. Since then, the public has become much more focused on lead hazards in water and testing for it, as well as other contaminants.

What is Lead

The Agency for Toxic Substances and Disease Registry (ATSDR) describes lead as a naturally occurring metal found in small amounts in the earth's crust. Lead can be found in all parts of the environment, including: air, water, and soil. Lead can also exist in many different chemical forms. It is considered a heavy metal and does not break down over time. Much of it comes from human activities including: burning fossil fuels, mining, and manufacturing. Lead has many different uses, including in the production of batteries, ammunition, metal products (solder and pipes), and devices to shield X-rays.

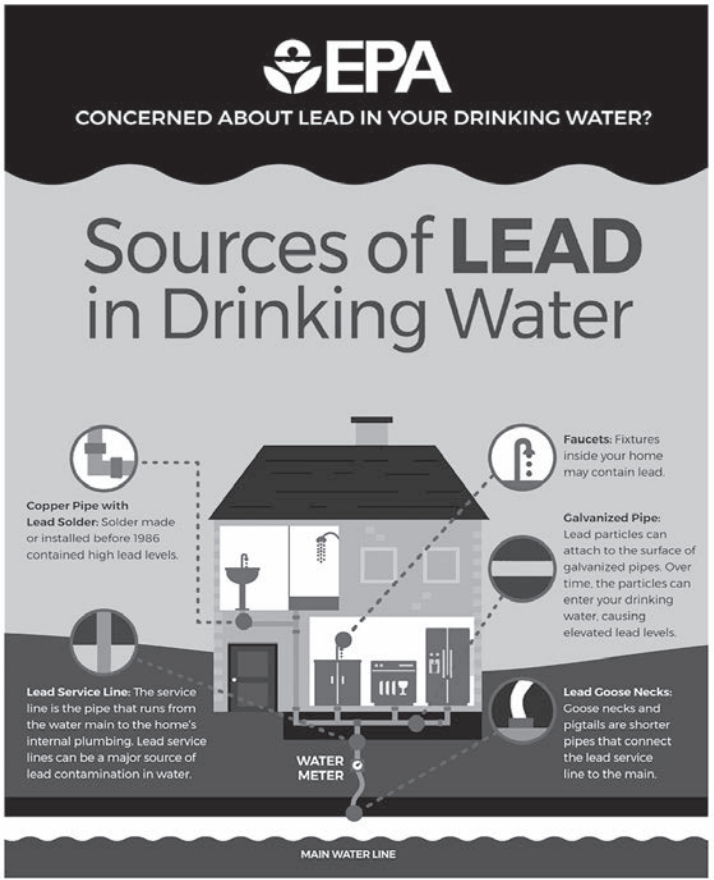
Lead rarely occurs naturally in water. In most circumstances, lead gets into the water from the delivery system. The U.S. Environmental Protection Agency (EPA) reports that lead can enter drinking water when plumbing materials that contain lead corrode, especially where the water has high acidity or low mineral content that corrodes pipes and fixtures.

Due to health concerns, lead from gasoline, paints and ceramic products, caulking, and pipe solder has been dramatically reduced in recent years.

What is Copper (Cu)

Copper (Cu) is a metal that occurs naturally throughout the environment, in rocks, soil, and water. Copper is an essential element in plants and animals (including humans) and is necessary for us to live. Plants and animals must absorb some copper from eating, drinking, and breathing. Copper is used to make many different kinds of products like wire, plumbing pipes, and sheet metal. Pennies manufactured in the U.S. before 1982 are made of copper, while those made after 1982 are only coated with copper. Copper is also combined with other metals to make brass, bronze pipes and faucets. Copper compounds are commonly used in agriculture to treat plant diseases like mildew, for water treatment and, as preservatives for woods, leathers, and fabrics.

Lead/Metals -37mm 0.8um MCE Cassette
#8715200
50 Pack
#8715200B



Ways Lead Can Enter Drinking Water

The most common sources of lead in drinking water are lead pipes, faucets, and fixtures. Lead pipes that connect the home to the water main, also known as lead services lines, are typically the most significant source of lead in the water.

Lead pipes are more likely to be found in older cities and homes built before 1986. Among homes without lead service lines, the most common problem is with brass or chrome-plated brass faucets and plumbing with lead solder.

This is of great concern as the EPA estimates that drinking water can make up 20 percent or more of a person's total exposure to lead. Infants who consume mostly mixed formula can receive 40 percent to 60 percent of their exposure to lead from drinking water.

Ghost Wipes
Free With Analysis by EMSL
#8708100
Centrifuge Tube, Transport Tube for Wipe
#8708907

250 mL Water Sampling Bottle(s)
Free With Analysis by EMSL
#87LM005

Corrosion of Lead Pipes, Fixtures, and Solder

Corrosion is the dissolving or wearing away of metal caused by a chemical reaction between water and the plumbing. A number of factors are involved in the extent to which lead enters the water according to the EPA, including:

- The chemistry of the water (pH or acidity and alkalinity)
- The types and amounts of minerals in the water
- The amount of lead the water comes into contact with
- The temperature of the water
- The amount of wear on the pipes
- How long water stays in the pipes
- The presence of protective coatings inside the plumbing materials

Gilian GilAir5R Pump with Single Charger
#8706209

EMSL Rotary Vane Pump
(Stand not included)
#8706102
Basic Sampling Stand
#8706901

Lead in Private Wells

Lead can contaminate the water in a private well through leaching from soil and through pipes to the building. The Centers for Disease Control and Prevention (CDC) reports that private wells more than 20 years old may contain lead in the "packer" element that is used to help seal the well above the well screen. Some brands of older submersible pumps used in wells may also contain leaded-brass components. Corrosion of pipes and fixture parts can cause lead to get into tap water.

Health Effects of Lead Exposure

Although lead poisoning is considered to be one of the most preventable environmental diseases, millions of people across the globe are still being exposed to it from various sources.

While people of all ages can be at risk of the effects of lead poisoning, for children, the EPA and CDC agree that there is no known safe lead level in a child's blood. Even low lead in children's blood have been shown to affect IQ, the ability to pay attention, and academic achievement.

The CDC reports that approximately half a million U.S. children ages 1-5 years old have blood lead levels above the blood lead value (5 micrograms per deciliter (μg/dL) or more) at which the agency recommends public health actions be initiated. Even low blood lead level in children can result in:

- Behavioral and learning problems
- Lower IQ and hyperactivity
- Slowed growth
- Hearing problems
- Anemia

Concerns for pregnant women include the fact that lead can accumulate in people's bodies over time, where it is stored in bones along with calcium. The CDC states that if a woman does not have enough dietary calcium during pregnancy, lead is released from bones as maternal calcium and is used to help form the bones of the fetus. Lead can also

cross the placental barrier exposing the fetus to lead. This can result in serious effects to the mother and her developing fetus, including:

- Reduced growth of the fetus
- Premature birth

Lead is also harmful to any adult. Adults exposed to lead can suffer from:

- Cardiovascular effects, increased blood pressure, and incidence of hypertension
- Decreased kidney function
- Reproductive problems (in both men and women)

Lead (Pb) Health Effects

Affected Organ Systems:
Neurological (Nervous System), Renal (Urinary System or Kidneys)

Cancer Classification:

Environmental Protection Agency (EPA)
- Probable human carcinogen.

International Agency for Research on Cancer (IARC)
- Inorganic lead – probably carcinogenic to humans.
- Not classifiable as to carcinogenicity to humans.
- Possibly carcinogenic to humans.

National Toxicology Program (NTP)
- Reasonably anticipated to be a human carcinogen.

Chemical Classification:
Inorganic substance

Copper (Cu) Health Effects

Affected Organ Systems:
Gastrointestinal (Digestive)

Cancer Classification:

Environmental Protection Agency (EPA)
- Not classifiable as to human carcinogenicity. IARC: Not evaluated.

National Toxicology Program (NTP)
- Not evaluated.

Chemical Classification:
Inorganic substance

Testing Your Water

The EPA does require all community water systems to prepare and deliver an annual water quality report called a Consumer Confidence Report (CCR) to their customers by July 1st of each year. The CCR provides a brief summary of the risk of contamination of the local drinking water source. It does not show what might be coming out of a faucet or drinking fountain due to lead and other contaminants that may have entered the water supply after the point at which the test was taken.

It is important to remember that homes, schools, and buildings may have service lines and internal plumbing materials containing lead. Since people cannot see, taste, or smell lead dissolved in water, testing is the only sure way of telling whether there are harmful quantities of lead in drinking water states the EPA.

Sampling Instructions: Lead & Copper

What EMSL Is Providing
- 250 mL Sampling bottle(s) (EMSL Product ID # 87LM005)
- Chain of Custody
- Original shipping box

What You Will Need Before Collecting Your Sample(s)
- Disposable gloves
- Eye protection
- 10% bleach and 90% water solution

Pre-Sampling Instructions
1. Save the original shipping box from EMSL to return the sample(s) to the laboratory for analysis.
2. Each bottle(s) and cap(s) is color-coded to match the test requested. Please match up the bottles to the instructions below:
    a. FIRST DRAW SAMPLE (#1)
    b. FLUSH SAMPLE (#2)
3. On all sample(s), use a gentle stream of water to prevent overflow or splashing.
4. Always wear gloves and eye protection when handling the bottle(s).
5. To avoid contaminating your sample(s): Please do not touch the inside of the bottle cap, or the inside of the bottle.
6. IMPORTANT: Collect your sample(s) in the morning Monday through Thursday. Ship everything back to the laboratory the same afternoon as collection. Please do not conduct sampling on Friday, Saturday, or Sunday.

Sampling Instructions (cont.)

Selecting Your Collection Location
1. Use a clean, properly functioning faucet in an area free of excessive dust or other sources of contamination. Non-swivel faucets are preferred.
2. Select a faucet without devices such as screens, aerators, hoses, or purification devices which may affect results. If present, please remove them and thoroughly spray or wipe the spout with a 10% bleach solution.
3. IMPORTANT: The faucet should be high enough to allow the bottle to fit underneath, without contacting the mouth of the bottle with the faucet (example: a bath tub or kitchen sink).
4. Before collecting your sample(s), please put on your gloves and eye protection.

Collection Instructions: FIRST DRAW SAMPLE (#1)
(YELLOW CAP BOTTLE)

1. Prior to collecting your sample: Allow the water in your pipes to sit undisturbed for a minimum of six hours. **Do not** flush the water in the pipes during the six hours.
2. Collect this sample first thing in the morning before anyone has used any water within the building. Do not run the water before collecting this sample.
3. Remove the cap from the YELLOW CAP bottle. Please hold the cap by its outside edges only, and slowly fill the bottle to the neck.
4. Collect the water from the cold tap filling the bottle but not overfilling.
5. Secure the cap to the bottle for shipment.

Sampling Instructions (cont.)

Collection Instructions: FLUSH SAMPLE (#2)
(YELLOW CAP BOTTLE)

6. Let the water run from the cold tap for at least 10 minutes before collecting your sample.
7. Remove the cap from the YELLOW CAP bottle. Please hold the cap by its outside edges only, and slowly fill the bottle to the neck.
8. Collect the water from the cold tap filling the bottle but not overfilling.
9. Secure the cap to the bottle for shipment.

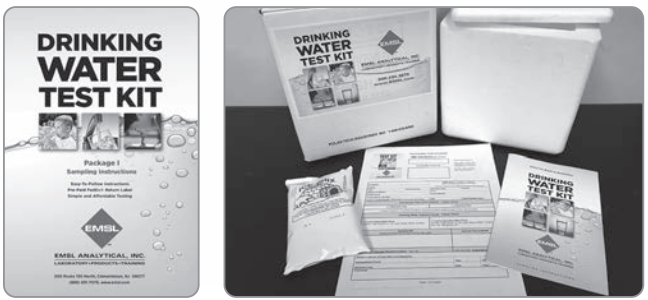
Returning Your Samples

1. Fill out the enclosed EMSL Chain of Custody form. Be sure to provide all contact and sample information along with signatures and dates requested.
2. Place your completed Chain of Custody along with your two bottles inside the original box for shipment. **Please do not add ice.**
3. Please ship your box back to EMSL on the SAME DAY you collect the sample(s).

EPA's Drinking Water Regulations for Lead

In 1974, Congress passed the Safe Drinking Water Act (SDWA). This law requires the EPA to determine the level of contaminants in drinking water at which no adverse health effects are likely to occur with an adequate margin of safety. These health goals are based solely on possible health risks and are called: Maximum Contaminant Level Goals (MCLGs). The MCLG for lead is zero. The EPA has set this level based on the best available science which shows there is no safe level of exposure to lead.

For most contaminants, the EPA sets an enforceable regulation called a maximum contaminant level (MCL) based on the MCLG. MCLs are set as close to the MCLGs as possible, considering cost verse benefits, and the ability of public water systems to detect and remove contaminants using suitable treatment technologies.



EMSL Offers A Wide Range Of Drinking Water Test Kits
All kits include: Easy-To-Follow Instructions, Pre-Paid Fedex® Return Label and Simple and Afordable Testing, Call (800) 220-3675 To Order!

Lead and Copper Rule (LRC)

The EPA issued the Lead and Copper Rule (LCR) in 1991 and revised the regulation in 2000 and 2007. States may set more stringent drinking water regulations than the EPA, but not less strigent.

The treatment technique regulation for lead and copper requires water systems to control the corrosivity of the water. The regulation also requires systems to collect tap samples from sites served by the system that are more likely to have plumbing materials containing lead. If more than 10 percent of tap water samples exceed the lead action level of 15 ppb, then water systems are required to take additional actions including:

- Taking further steps optimize their corrosion control treatment (for water systems serving 50,000 people that have not fully optimized their corrosion control)
- Educating the public about lead in drinking water and actions consumers can take to reduce their exposure to lead
- Replacing the portions of lead service lines (lines that connect distribution mains to customers) under the water system's control

Exceedances vs. Violations

Exceeding the action level is not a violation. Violations can be assessed if a system does not perform certain required actions (e.g., public education or lead service line replacement) after the action level is exceeded. Other violations may also be assessed under the rule. For example, if samples are collected improperly, samples are not reported, or if treatment is done incorrectly.

Implementation and Next Steps

Implementation of the LCR over the past 25 years has resulted in major improvements in public health. The number of the nation's large drinking water systems that have exceeded the LCR action level has decreased by over 90 percent since the initial implementation of the rule. Based on the June 2019 Safe Drinking Water Information System (SDWIS) data, about 97 percent of the systems have not reported an action level exceedance in the last three years.

The EPA is continuing to work with primacy agencies to ensure that the LCR is being properly implemented.

The EPA has recently released the proposed rule for public comment. To learn more visit: www.epa.gov/safewater/lcrproposal.

Lead and Copper Rule Quick Reference Guide

Overview of the Rule

Title[1]	Lead and Copper Rule (LCR)[2], 56 FR 26460 - 26564, June 7, 1991
Purpose	Protect public health by minimizing lead (Pb) and copper (Cu) levels in drinking water, primarily by reducing water corrosivity. Pb and Cu enter drinking water mainly from corrosion of Pb and Cu containing plumbing materials.
General Description	Establishes action level (AL) of 0.015 mg/L for Pb and 1.3 mg/L for Cu based on 90th percentile level of tap water samples. An AL exceedance is not a violation but can trigger other requirements that include water quality parameter (WQP) monitoring, corrosion control treatment (CCT), source water monitoring/treatment, public education, and lead service line replacement (LSLR).
Utilities Covered	All community water systems (CWSs) and non-transient non-community water systems (NTNCWSs) are subject to the LCR requirements.

Public Health Benefits

Implementation of the LCR has resulted in	► Reduction in risk of exposure to Pb that can cause damage to brain, red blood cells, and kidneys, especially for young children and pregnant women. ► Reduction in risk of exposure to Cu that can cause stomach and intestinal distress, liver or kidney damage, and complications of Wilson's disease in genetically predisposed people.

Major Monitoring Provisions

Lead and Copper Tap

Applicability	► All CWSs and NTNCWSs.
Standard	► CWSs and NTNCWSs must collect first-draw samples at taps in homes/buildings that are at high risk of Pb/Cu contamination as identified in 40 CFR 141.86(a). ► Number of samples is based on system size (see Table 1). ► Systems must conduct monitoring every 6 months unless they qualify for reduced monitoring.
Reduced	► See Table 1 for sample number and Table 2 for criteria.

Water Quality Parameter (WQP)

Applicability	► Systems serving > 50,000 people. ► Systems serving ≤ 50,000 during monitoring periods in which either AL is exceeded.
Standard	► WQP samples at taps are collected every 6 months. ► WQPs at entry points to distribution system (EPTDS) are collected every 6 months prior to CCT installation, then every 2 weeks.
Reduced	► See Table 1 for sample number and page 2 for criteria. Does not apply to EPTDS WQP monitoring.

Table 1: Lead and Copper Tap and WQP Tap Monitoring

Size Category	System Size	Number of Pb/Cu Tap Sample Sites[3]		Number of WQP Tap Sample Sites[4]	
		Standard	Reduced	Standard	Reduced
Large	> 100K	100	50	25	10
	50,001 - 100K	60	30	10	7
Medium	10,001 - 50K	60	30	10	7
	3,301 - 10K	40	20	3	3
Small	501 - 3,300	20	10	2	2
	101 - 500	10	5	1	1
	≤ 100	5	5	1	1

[3] With written State approval, PWSs can collect < 5 samples if all taps used for human consumption are sampled.
[4] Two WQP tap samples are collected at each sampling site.

Lead and Copper Rule Quick Reference Guide

Major Monitoring Provisions

Water Quality Parameter (WQP)

Table 2: Criteria for Reduced Pb/Cu Tap Monitoring

Annual	1. PWS serves ≤ 50,000 people and is ≤ both ALs for 2 consecutive 6-month monitoring periods; or 2. Any PWS that meets optimal WQPs (OWQPs) and is ≤ Pb AL for 2 consecutive 6-month monitoring periods.
Triennial	1. PWS serves ≤ 50,000 people and is ≤ both ALs for 3 consecutive years of monitoring; or 2. Any PWS that meets OWQP specifications and is ≤ Pb AL for 3 consecutive years of monitoring; or 3. Any PWS with 90th percentile Pb and Cu levels ≤ 0.005 mg/L and ≤ 0.65 mg/L, respectively, for 2 consecutive 6-month monitoring periods (i.e., accelerated reduced Pb/Cu tap monitoring).
Every 9 years	PWS serves ≤ 3,300 people and meets monitoring waiver criteria found at 40 CFR 141.86(g).

Lead Consumer Notice

Within 30 days of learning the results, all systems must provide individual Pb tap results to people who receive water from sites that were sampled, *regardless of whether the results exceed the Pb AL*, as required by 40 CFR 141.85(d).

Consumer Confidence Report (CCR)

All CWSs, irrespective of their lead levels, must provide an educational statement about lead in drinking water in their CCRs as required by 40 CFR 141.154. Must be in 2008 CCR (due July 1, 2009) if EPA is Primacy Agency, State adopts the rule by reference automatically, or adopts during 2008. Otherwise, this statement is required in the 2009 CCR (due July 1, 2010).

Treatment Technique and Sampling Requirements if the AL is Exceeded[5]

[5] Based on 90th percentile level. Multiply number of valid samples by 0.9 (e.g., 10 samples x 0.9 = 9; thus, use 9th highest Pb and Cu test result to compare to AL). For 5 samples, average 4th and 5th highest results. For < 5 samples, use highest result.

Water Quality Parameter (WQP)

Applicability	Refer to page 1.
Parameters	► pH, alkalinity, calcium *(initial only, unless calcium carbonate stabilization is used)*, conductivity *(initial monitoring only)*, orthophosphate *(if inhibitor is phosphate-based)*; silica *(if inhibitor is silicate-based)*, and temperature *(initial monitoring only)*.
Frequency	► Systems installing CCT, must conduct follow-up monitoring for 2 consecutive 6-month periods. ► WQP tap monitoring is conducted every 6 months, EPTDS monitoring increases to every 2 weeks. ► After follow-up monitoring, State sets OWQP specifications that define optimal CCT.
Reduced Tap Monitoring	► Collect reduced number of sampling sites (see Table 1) if meet OWQPs for 2 consecutive 6-month periods. ► Collect reduced number of sampling sites at reduced frequency if meet OWQPs for: – 6 consecutive 6-month monitoring periods can monitor annually; – 3 consecutive years of annual monitoring can monitor triennially.

Lead and Copper Rule Quick Reference Guide

Treatment Technique and Sampling Requirements if the AL is Exceeded[5]	
[5] Based on 90th percentile level. Multiply number of valid samples by 0.9 (e.g., 10 samples x 0.9 = 9; thus, use 9th highest Pb and Cu test result to compare to AL). For 5 samples, average 4th and 5th highest results. For < 5 samples, use highest result.	
Public Education (PE)	
Applicability	► Systems that exceed the Pb AL (*not required if only the Cu AL is exceeded*).
Purpose	► Educates consumers about lead health effects, sources, and steps to minimize exposure.
Delivery Method	► CWSs: deliver materials to bill-paying customers and post lead information on water bills, work in concert with local health agencies to reach at-risk populations (children, pregnant woman), deliver to other organizations serving "at-risk" populations, provide press releases, include new outreach activities from list in 40 CFR 141.85(a)(2)(vi), and post to Web site (CWSs serving > 100,000 only). ► NTNCWSs: posting and distribution to all consumers (can be electronic with State permission). Can apply to CWSs such as hospitals and prisons where population cannot make improvements.
Timing	► Within 60 days *after end of monitoring period* in which Pb AL was exceeded if not already delivering PE.[6] ► Repeat annually except: water bill inserts - quarterly; press releases - 2x/year, and Web posting - continuous. ► Can discontinue whenever ≤ Pb AL but must recommence if subsequently exceed Pb AL.
[6]State may allow extension in some situations. Also, State may require approval of message content prior to delivery.	
Source Water Monitoring and Source Water Treatment (SOWT)	
Applicability	► Systems that exceed Pb or Cu AL.
Purpose	► Determine contribution from source water to total tap water Pb and Cu levels and need for SOWT.
Timing	► One set of samples at each EPTDS is due within 6 months of first AL exceedance. ► System has 24 months to install any required SOWT. ► State sets maximum permissible levels (MPLs) for Pb and Cu in source water based on initial and follow-up source water monitoring.
Standard	► Ground water PWSs monitor once during 3-year compliance periods; surface water PWSs monitor annually.
Reduced	► Monitor every 9 years if MPLs are not exceeded during 3 consecutive compliance periods for ground water PWSs or 3 consecutive years for surface water PWSs.
Corrosion Control Treatment (CCT)	
Applicability	► All large systems except those meeting requirements of 40 CFR 141.81(b)(2) or (b)(3). ► Medium and small systems that exceed either AL; may stop CCT steps if ≤ both ALs for 2 consecutive 6-month periods but must recommence CCT if subsequently exceed either AL.
Study	► All large systems except as noted above. ► If State requires study for small or medium systems, it must be completed within 18 months.
Treatment	► Once State determines type of CCT to be installed, PWS has 24 months to install. ► Systems installing CCT must conduct 2 consecutive 6 months of follow-up tap and WQP monitoring.
OWQPs	► After follow-up Pb/Cu tap and WQP monitoring, State sets OWQPs. *Refer to WQP section above.*
Lead Service Line Replacement (LSLR)	
Applicability	► Systems that continue to exceed the Pb AL after installing CCT and/or SOWT. ► Can discontinue LSLR whenever ≤ Pb AL in tap samples for 2 consecutive 6-month monitoring periods; must recommence if subsequently exceed.
Monitoring	► Optional: Sample from LSL to determine if line must be replaced. If all samples are ≤ 0.015 mg/L, line is considered "replaced through testing"; must reconsider these lines if Pb AL is subsequently exceeded. ► Required: Sample from any LSLs not completely replaced to determine impact on Pb levels.
Replacement	► Must replace at least 7% of LSLs annually; State can require accelerated schedule. ► If only portion of LSL is replaced, PWS must: – Notify customers at least 45 days prior to replacement about potential for increased Pb levels. – Collect samples within 72 hours of replacement and provide results within 3 days of receipt.

Additional EMSL Test Kits

Call (800) 220-3675 for more information.

Notes

Sources

https://www.epa.gov/ground-water-and-drinking-water/basic-information-about-lead-drinking-water
https://www.cdc.gov/nceh/lead/prevention/sources/water.htm
https://www.atsdr.cdc.gov/toxfaqs/tf.asp?id=93&tid=22
https://www.cdc.gov/healthywater/drinking/private/wells/disease/lead.html
https://www.cdc.gov/features/leadpoisoning/index.html
https://www.cdc.gov/nceh/lead/prevention/default.htm

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