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# **LEAD AND COPPER RULE**

## **GUIDANCE MANUAL**

### **VOLUME II: Corrosion Control Treatment**

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# **LEAD AND COPPER RULE GUIDANCE MANUAL**

## **Volume II: Corrosion Control Treatment**

**for**

**Drinking Water Technology Branch  
Drinking Water Standards Division  
Office of Ground Water and Drinking Water  
U.S. Environmental Protection Agency  
Washington, D.C.**

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by**

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# Preface

On June 7, 1991, the U.S. Environmental Protection Agency promulgated NPDWRs for lead and copper. EPA is developing a guidance manual in two volumes to assist water systems and State regulatory agencies in implementing the technical requirements of the rule. The first volume of the *Lead and Copper Rule Guidance Manual* addressed the monitoring requirements of the rule. The second volume of the *Lead and Copper Rule Guidance Manual* concentrates on corrosion control treatment and lead service line replacement.

This volume focuses on the evaluation of corrosion control treatment options and optimization of the full-scale treatment. The manual discusses the procedures that can be used by water systems to determine the appropriate corrosion control treatment. The manual discusses the available testing protocols for conducting the demonstration studies that many large systems will be required to perform prior to making their treatment

recommendation to the State. For smaller systems, the manual contains a summary of case studies separated by the raw water quality to assist these systems in making their treatment recommendation to the State. The manual also provides guidance to assist State regulatory agencies in reviewing data from corrosion control studies and in specifying optimal water quality parameters. An additional chapter provides guidance on the lead service line replacement requirements. The subject matter discussed in this chapter includes what constitutes a replacement of a lead service line, replacement schedules, and the criteria for discontinuing lead service line replacements.

I hope that this volume of the manual will be a practical tool for water systems and State regulatory agencies in implementing the corrosion control treatment and lead service line replacement requirements of the lead and copper rule.

James R. Elder

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## *Glossary of Terms<sup>1</sup>*

<b>TERM</b>	<b>DESCRIPTION</b>
<b>Calcium Adjustment</b>	The addition of calcium to shift chemical equilibria to produce a less corrosive water.
<b>Consecutive System</b>	A public water system (PWS) which receives treated water from another PWS where the interconnection of the systems justifies treating them as a single system for monitoring purposes.
<b>Corrosion Inhibitor</b>	A chemical, usually phosphate or silicate based, that can be used to reduce corrosion.
<b>Corrosion Control Study</b>	A desk-top evaluation, static testing, or flow through testing designed to identify optimal corrosion treatment.
<b>Corrosion Control Treatment</b>	Treatment to minimize the dissolution of lead and/or copper during water delivery to consumers.
<b>Coupon</b>	Piece of metal used to evaluate the rate of corrosion by insertion into piping systems.
<b>Demonstration Testing</b>	Flow through or static testing methods used to illustrate the effectiveness of a particular corrosion control treatment.
<b>Desk-Top Evaluation</b>	An office study which compiles historical information and literature to assist in determining appropriate corrosion control treatment.
<b>Flow-Through Testing</b>	An experimental approach which uses a pipe loop(s) or other apparatus that provides moving water to contact the testing surfaces.
<b>First-Draw Tap Sample</b>	One-liter sample collected from the kitchen or bathroom cold-water faucets of targeted sample sites representing water standing in the interior piping for at least six hours.
<b>Large Water System</b>	A water system that serves more than 50,000 persons.
<b>LSL Sample</b>	One-liter samples collected from locations served by lead service lines (LSLs) representing water standing in the LSL for at least six hours.
<b>Materials Survey</b>	An investigation of the materials used in home plumbing and service lines to assist PWSs in located targeted sample sites.
<b>Medium-Size Water System</b>	A water system that serves greater than 3,300 and less than or equal to 50,000 persons.

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<sup>1</sup>This glossary provides general descriptions of some of the technical terms used in this manual. Some of these terms are also defined in the lead and copper rule (see 40 CFR section 141.2). The definitions in this document, although worded somewhat differently, are intended to be consistent with the Agency's regulatory definitions.

<b>TERM</b>	<b>DESCRIPTION</b>
<b>Non-Parametric Statistics</b>	Statistical measures of relative behavior between two or more sets of data not predicated on the data being normally distributed.
<b>Passivation</b>	A corrosion control technique which incorporates the pipe materials into metal/hydroxide/carbonate compounds intended to protect the pipe.
<b>pH/Alkalinity Adjustment</b>	The addition of chemicals to modify the pH and/or alkalinity to produce a less corrosive water.
<b>Phosphate Inhibitor</b>	A phosphate based chemical intended to reduce corrosion when added to water.
<b>Pipe Insert</b>	Pipe sections used to evaluate the rate of corrosion by insertion into piping systems.
<b>Pipe Loop</b>	An experimental apparatus consisting of several feet of pipe complete with joints, elbows, and connections for flow through testing.
<b>Pipe Rig</b>	The overall apparatus used for flow through testing which may consist of several individual pipe loops.
<b>Precipitation</b>	The shifting of chemical equilibria to cause the formation of a solid protective coating, usually calcium carbonate, on interior pipe surfaces.
<b>Sample Plan</b>	A description of the sampling locations and criteria for targeted sample sites for first-draw tap, distribution system, and point of entry samples.
<b>Sample Pool Category</b>	The sample pool category of a PWS reflects the relative priority of targeted sample sites able to be identified and included in the sample plan for first-draw tap samples.
<b>Small Water System</b>	A water system that serves 3,300 persons or fewer.
<b>Silicate Inhibitor</b>	A silicate based chemical intended to reduce corrosion when added to water.
<b>Source Water Sample</b>	Samples collected at the entry point(s) to the distribution system representative of each source of supply after treatment.
<b>Source Water Treatment</b>	Removal of lead and/or copper from the source of supply.
<b>Static Testing</b>	An experimental approach that retains the testing surfaces within standing water.
<b>Weight-Loss Measurement</b>	An approved method of determining the amount of metal lost to corrosion from a pipe insert or coupon.

**ACRONYM****DEFINITION**

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	Asbestos-Cement.
<b>AL</b>	Action Level - the level of lead or copper in first-draw tap samples which when exceeded triggers additional compliance actions on the part of PWSs.
<b>ASTM</b>	The American Society for Testing and Materials.
<b>AWWA</b>	The American Water Works Association.
<b>AWWARF</b>	The American Water Works Association Research Foundation.
<b>BAT</b>	Best Available Technology.
<b>CCPP</b>	Calcium Carbonate Precipitation Potential.
	The product of disinfectant concentration (C) in mg/L and the effective contact time (T) in minutes.
	Actual CT value achieved across a single disinfection segment.
	Required CT value for a specific level of <i>Giardia</i> or virus inactivation as a function of temperature, pH, and in the case of free chlorine, disinfectant residual.
<b>Cu</b>	Copper
<b>Cu-POE</b>	Copper concentration at Point of Entry.
<b>DBPs</b>	Disinfection By-Products
<b>DBPR</b>	Disinfection By-Products Rule
<b>CWS</b>	Community Water System
<b>GAC</b>	Granular Activated Carbon
<b>GWDR</b>	Ground Water Disinfection Rule
<b>HPC</b>	Heterotrophic plate count.
<b>LCR</b>	Lead and Copper Rule.
	Lead Service Line.
<b>LSLRP</b>	Lead Service Line Replacement Program.
<b>NTNCWSs</b>	Non-Transient, Non-Community Water Systems.
<b>NSF</b>	National Sanitation Foundation.
<b>Pb</b>	Lead
<b>Pb/Cu-POE</b>	Lead and copper samples collected at the points of entry to the distribution system representative of each source of supply after treatment.
<b>Pb/Cu-TAP</b>	Lead and copper samples collected as first-draw tap samples from targeted sample sites.

<b>ACRONYM</b>	<b>DEFINITION</b>
<b>POE</b>	Points of Entry to the distribution system representative of each source of supply after treatment. Used to describe source water monitoring activity.
<b>PQL</b>	Practical Quantitation Level
<b>PWS</b>	Public Water System
<b>QA/QC</b>	Quality Assurance and Quality Control measures to ensure reliable data are collected.
<b>SDWA</b>	Safe Drinking Water Act of 1974 as amended in 1986.
<b>SWTR</b>	Surface Water Treatment Rule.
<b>SOCs/IOCs</b>	Synthetic Organic Chemicals/Inorganic Chemicals - Classes of chemical compounds.
<b>SDSTTHM</b>	Simulated Distribution System Total Trihalomethanes.
<b>TCR</b>	Total Coliform Rule.
<b>THAAs</b>	Total HaloAcetic Acids.
<b>THM</b>	Trihalomethane.
<b>TTHMs</b>	Total Trihalomethanes.
<b>WQP</b>	Water Quality Parameters, defined in the Rule to include pH, temperature, conductivity, alkalinity, calcium, orthophosphate, and silica.
<b>WQP-POE</b>	Water Quality Parameters measured at the Points Of Entry to the distribution system representative of each source of supply after treatment.
<b>WQP-DIS</b>	Water Quality Parameters measured at representative locations throughout the DIStribution system.
<b>WTP</b>	Water Treatment Plant.
<b>90%Cu-Tap</b>	The 90% copper level for first-draw tap samples collected at targeted sample sites.
<b>90%Pb-Tap</b>	The 90% lead level for first-draw tap samples collected at targeted sample sites.
<b>[(90%Pb-Tap) - (Pb-POE)]</b>	The difference between the 90% lead level for first-draw tap samples collected at targeted sample sites and the highest respective lead level measured at the points of entry to the distribution system.

## Chapter 1.0 — Introduction

The Lead and Copper Rule (LCR) was promulgated by EPA on June 7, 1991 as a treatment technique requirement with major provisions to be implemented over the following decade. The public water systems (PWSs) that are subject to compliance with the LCR are community water systems and non-transient non-community water systems. These PWSs must either demonstrate that optimal treatment has been installed to control lead and copper or else that the existing lead and copper levels in consumers' tap water are below acceptable levels. In addition to the water treatment requirements contained in the LCR, public education and lead service line (LSL) replacement provisions are part of the lead and copper national primary drinking water regulations.

In order to assist States in implementing the requirements of the LCR, the EPA has issued the LCR Guidance Manual. Information regarding all components of the Rule are discussed in the Guidance Manual, along with supporting suggestions and direction for State and PWS actions which may be needed to fully implement the Rule according to its intent.

The LCR Guidance Manual has been issued in two volumes and is intended to assist States and PWSs alike in furthering their understanding of the LCR and its implementation. The first volume was released by EPA in September 1991 and focuses on the monitoring portion of the Rule. This second volume presents guidance on implementing optimal corrosion

control treatment and the LSL replacement aspects of the LCR. A separate document has been prepared to assist PWSs in developing and conducting an effective public education program in response to the LCR (USEPA, 1992).

The information presented in the LCR Guidance Manual is not limited to the strict terms of the LCR. Supplemental information that may be useful to PWSs is also provided regarding such topics as performing corrosion studies, evaluating material survey data for LSL replacement, and formulating recommendations for optimal treatment. Table 1-1 presents the location of selected "topics" in which most PWSs and/or State agencies would be interested.

It is not the intent of the LCR Guidance Manual to be an authoritative reference on corrosion control - in theory or in practice - but, rather, to (1) provide direction about the implementation of the corrosion control aspects of the LCR; (2) indicate sources of additional information regarding the application of theoretical and practical aspects of corrosion control treatment/evaluations; and (3) present a logical and reasonable direction for evaluating optimal corrosion control treatment and performance for PWSs.

The Lead and Copper Guidance Manual is intended to provide supporting direction to States and public water suppliers so that the requirements of the Lead and Copper Rule may be achieved. The focus of the manual is to supplement materials readily available in the literature, referring

## INTRODUCTION

to these information sources for further reading where appropriate, and to provide practical suggestions and recommendations for accomplishing the objectives of the Rule. This document is designed to provide technical guidance to primacy agencies administering the SDWA as they exercise their judgment in implementing the national primary drinking water regulations for lead and copper. This guidance is a general statement of policy which does not establish a binding norm on primacy

agencies or public water systems and is not finally determinative of the issues addressed. Decisions made in any particular case will be governed by the applicable provisions of the SDWA and 40 CFR Parts 141 and 142.

### *1.1 Reference*

USEPA. 1992. *Lead in Drinking Water Regulation: Public Education Guidance*. Office of Water (Washington, D.C.).



**Table 1-1. Topical Locator by Subject Matter for Lead and Copper Rule Guidance Manual**

Subject Matter	LCR Guidance Manual — Volume II									LCR GM VOL. 1 *	LCR GM Pub. Ed. **	
	Chapters						Appendices					
	1	2	3	4	5	6	A	B	C			
<b>Requirements by System Size</b>												
Small		✓	✓	✓	✓	✓					✓	✓
Medium		✓	✓	✓	✓	✓					✓	✓
Large		✓	✓	✓	✓	✓					✓	✓
<b>Principles of Corrosion</b>			✓				✓					
<b>Corrosion Control Treatment Alternatives</b>			✓									
<b>Regulatory Requirements</b>												
Intent of the LCR	✓											
Who Must Perform Studies		✓										
Corrosion Study Requirements		✓										
Recommending Treatment		✓	✓	✓								
Setting Operational Criteria					✓							
Replacing LSLs						✓						
State Actions		✓	✓	✓	✓	✓						
Monitoring Requirements					✓	✓					✓	
Public Education												✓
<b>Desk-Top Evaluations</b>												
Steps in Desk-Top Evaluations			✓									
Source Water Treatment Guidelines			✓									
Suggested Treatment by Water Quality Criteria			✓				✓					
Constraints in Defining Optimal Treatment			✓									
Reporting Forms & Checklists			✓									
Case Studies			✓					✓				

**Table 1-1. Topical Locator by Subject Matter for Lead and Copper Rule Guidance Manual (continued)**

Subject Matter	LCR Guidance Manual — Volume II									LCR GM VOL. 1 *	LCR GM Pub. Ed. **
	Chapters						Appendices				
	1	2	3	4	5	6	A	B	C		
Demonstration Testing				✓							
Scope of Studies				✓							
Organization				✓							
Flow-Through Testing				✓							
Static Testing				✓							
Measurement Techniques				✓							
Data Handling				✓						✓	
Non-Parametric Statistics				✓						✓	
Secondary Testing Programs				✓							
QA/QC Components				✓							
Examples				✓					✓		
Recommending Optimal Treatment		✓	✓	✓					✓		
Operating Full-Scale Treatment											
Setting Operational Criteria					✓						
Start-Up Operations					✓						
Troubleshooting					✓						
Implementing Optimal Treatment					✓						
Examples					✓				✓		

\* USEPA. 1991. *Lead and Copper Rule Guidance Manual — Volume 1*. Office of Ground Water and Drinking Water (Washington, D.C.).

\*\* USEPA. 1992. *Lead in Drinking Water — Public Education Guidance*. Office of Ground Water and Drinking Water (Washington, D.C.).

## Chapter 2.0 — Regulatory Requirements for Corrosion Control Studies

The regulatory requirements in the LCR for corrosion control studies are presented below with recommendations regarding the implementation of these requirements by primacy agents, namely state drinking water authorities.

### 2.1 Large PWSs

Large PWSs subject to the provisions of the LCR are any community water system (CWS) or non-transient non-community water system (NTNCWS) which serves populations over 50,000 people. All large PWSs are required to define and maintain optimal corrosion control treatment within their jurisdiction. This may be the treatment currently in-place or an alternative treatment recommended as a result of performing a corrosion control study.

#### 2.1.1 Regulatory Requirements

The Rule (141.82(c), 56 FR 26550) specifies six conditions to be met when performing a corrosion control study as described below:

- Evaluate the effectiveness of each of the following treatment and, if appropriate, any combinations of these approaches:
  - Alkalinity and pH Adjustment
  - Calcium Hardness Adjustment, and
  - Phosphate- or silicate-based corrosion inhibitors.
- Collect data from pipe rig/loop tests, metal coupon tests, partial-system tests (full-scale), or from documented, analogous treatments used in or tested at other systems of similar size, water chemistry, and distribution system configuration.
- Analyze the following water quality parameters in the course of testing: lead, copper, pH, alkalinity, calcium, conductivity, water temperature, and orthophosphate or silicate when an inhibitor containing the respective compound is used.
- Identify constraints (chemical or physical) which may limit the application of a particular treatment option. The existence of one of the following conditions should be documented as part of this process:
  - A particular corrosion control treatment has adversely affected other water treatment processes when used by another PWS with comparable water quality characteristics; and/or,
  - From the experience of the PWS, a particular corrosion control treatment was found to be ineffective and/or to adversely affect other water treatment processes.
- Assess the secondary impacts due to the effect of corrosion control treatment on other water treatment processes.

- **Recommend to the State** the optimal corrosion control treatment as identified by the PWS based on an analysis of the available data with supporting documentation and rationale.

While each of the above elements present important pieces of a corrosion control study, the organization and execution of a study are left to the PWS.

#### **2.1.1.1 Scope of testing activities.**

By requiring all systems conducting studies to evaluate specific treatment alternatives, EPA did not intend for each PWS to construct pipe rigs or conduct bench-scale tests to accommodate any and all treatment options. EPA anticipated that preliminary screening or "desk-top" evaluations would be utilized as an initial step to limit study comparisons and costs. Alternatives would generally be screened on the basis of available findings from: (1) other corrosion control studies for systems with comparable water quality; (2) theoretical and applied research efforts; and (3) the potential adverse impacts associated with treatment modifications. As a result of the desk-top evaluation, the most feasible alternatives can be selected (at most, two or three treatment options) for additional evaluation through demonstration testing. EPA believes that, in certain cases, the results of the desk-top evaluation could suffice in the selection of optimal treatment, and additional testing may not be required. However, any PWS that does not conduct a thorough evaluation of its treatment recommendation must realize the risks involved. A desk-top evaluation considers alternatives based on the experience of other PWSs and product manufacturers' recommendations.

As each PWS has a unique supply, treatment, and distribution system, assurance that the recommended treatment will be effective is lacking without actual demonstration testing.

As discussed previously, demonstration testing may not be necessary for some large PWSs to identify optimal treatment. Table 2-1(a) presents a recommended matrix of the minimum degree of testing to be performed by large PWSs based on the results of initial monitoring for lead. The only provision of the Rule which classifies the existing treatment of large PWSs as optimized for corrosion control is when the difference between the 90%Pb-TAP and Pb-POE is less than the lead PQL for each six-month period of the initial monitoring program. By definition, the PQL for lead is 0.005 mg/L; and the lead value for the source water used in this determination is the highest source water lead concentration. If this condition is met, then no study or testing is required. However, States may consider the presence of copper in tap samples when determining whether the existing treatment is optimized.

Large PWSs, while not experiencing problems with lead corrosion (when  $[(90\% \text{ Pb-Tap}) - (\text{Pb-POE})] < \text{PQL}$ , may find elevated levels of copper for which corrosion control treatment would be warranted. The recommended level of effort for corrosion control studies by large PWSs based on copper is presented in Table 2-1(b).

#### **2.1.1.2 Source water treatment.**

PWSs are only required to monitor lead and copper at the points of entry (Pb/Cu-POE) if either AL is exceeded on

**Table 2-1a. Minimum Recommended Corrosion Control Study Components for Large PWSs. Based on Lead Levels**

90th Percentile Tap Lead Level, $\mu\text{g/L}$	Source Water (POE) Lead Level, $\mu\text{g/L}$		
	Pb-POE < PQL	PQL < Pb-POE < 10	Pb-POE > 10
90% Pb-TAP < PQL	None Required	-----	-----
PQL < 90% Pb-TAP < 10	If $[(90\% \text{ Pb-TAP}) - (\text{Pb-POE})] < \text{PQL}$ , then None Required; Otherwise, Desk-Top Evaluation	None Required	-----
10 < 90% Pb-TAP < 15	Desk-Top Evaluation	If $[(90\% \text{ Pb-TAP}) - (\text{Pb-POE})] < \text{PQL}$ , then None Required; Otherwise, Desk-Top Evaluation	No Corrosion Control Testing Source Water Treatment Recommended or Required
90% Pb-TAP > 15	Desk-Top Evaluation and Demonstration Testing	Desk-Top Evaluation and Demonstration Testing	If $[(90\% \text{ Pb-TAP}) - (\text{Pb-POE})] < \text{PQL}$ , then only Source Water Treatment Required; Otherwise, Desk-Top Evaluation and Demonstration Testing and Source Water Treatment Recommended or Required

**Table 2-1b. Recommended Corrosion Control Study Components for Large PWSs. Based on Copper Levels**

90th Percentile Tap Copper Level, $\mu\text{g/L}$	Source Water (POE) Copper Level, $\mu\text{g/L}$	
	Cu-POE > AL	Cu-POE < AL
90% Cu-Tap > 1.3 mg/L	Desk-Top Evaluation, Demonstration Testing* and Source Water Treatment Required	Desk-Top Evaluation and Demonstration Testing*
90% Cu-Tap < 1.3 mg/L	-----	None Required

\* The focus of the desk-top evaluation and demonstration testing should be to select a corrosion treatment process that will reduce copper levels without adversely affecting lead levels.

the basis of first-draw tap samples. Systems may choose to monitor the source water contribution of these metals simultaneously with first-draw tap sampling in order to determine whether the existing treatment is optimal with regard to corrosion control (90%Pb-Tap - Pb-POE < PQL). Otherwise, this monitoring must be completed within six months of exceeding the lead or copper AL.

Source water treatment recommendations must be submitted to the State within six months of exceeding an AL for any system. Guidelines for source water treatment needs are presented in chapter 3.0 (see Table 3-5). If the source water is contributing more than the AL for either lead or copper, then source water treatment is required. In those cases where a significant amount of lead or copper is present, then treatment is recommended in order to reduce the overall lead or copper exposure and to assist PWSs in meeting the ALs in future monitoring events. Table 3-5 also shows that source water treatment is optional when moderate levels of metals are found, and unnecessary when very low levels of either lead or copper are present.

In those cases where systems find elevated levels of lead or copper at the points of entry, the sources of supply (raw water) should be monitored prior to treatment and at various stages within the existing treatment facility (if currently treating the supply) to determine the source of the metals. This monitoring will also assist in assessing the performance of the existing treatment systems to remove lead and copper.

Several types of treatment may be appropriate for removal of lead and copper.

EPA specified the following techniques within the LCR (USEPA, 1991):

- Ion Exchange
- Reverse Osmosis
- Lime Softening
- Coagulation/Filtration

If a PWS is currently providing conventional treatment (whether alum or ferric coagulation, iron/manganese removal, or lime softening), optimizing these treatment processes may improve lead and copper removals. If treatment is not available, package treatment units for any of the above technologies may be installed at individual wellheads (especially when the elevated metals are contributed by a small number of individual wells) or at a centralized treatment location. In the case of elevated copper, better control or elimination of copper sulfate applications may reduce the background level of copper for some surface water supplies.

States must respond to the recommendations for source water treatment within six months. If required, PWSs have 24 months to install source water treatment once approved by the State. For large PWSs, the installation of source water treatment could precede corrosion control treatment by as much as 18 months. Follow-up monitoring for Pb/Cu-POE and first-draw lead and copper tap samples will occur simultaneously after corrosion control treatment has been installed.

### ***2.1.2 State Actions and Decisions.***

Primacy Agencies, or States, are responsible for the review of corrosion study reports which support the PWS's recommendation regarding optimal

corrosion control treatment. State approval for study design and implementation is not required, although it would clearly benefit most PWSs to involve States in the planning of a corrosion control study so that the decisions and criteria used in selecting optimal treatment are acceptable to all parties.

In cases where the lead or copper ALs are exceeded during initial monitoring, PWSs must submit source water monitoring results and a source water treatment recommendation to the State within six months. After an additional six-month period, States must determine whether source water treatment is required. When treatment is necessary, PWSs have 24 months to install the treatment facilities and have them operational.

## ***2.2 Small and Medium Size PWSs***

Small and medium-size PWSs are any CWS or NTNCWS serving 3,300 people or less and 3,300 - 50,000 people, respectively. Corrosion control studies are not required for these systems unless an AL is exceeded.

### ***2.2.1 Regulatory Requirements.***

The LCR requires small and medium-size PWSs to perform initial first-draw tap monitoring for lead and copper at targeted sites located within their service area. If either the lead or copper AL is exceeded during a six-month monitoring period, the PWS must submit recommendations for optimal treatment to the State within six months of exceeding the AL. For example, a small PWS begins tap sampling for lead

and copper in July 1993 and by the end of the first monitoring event (December 1993), the system discovers that the lead AL was exceeded. The monitoring results must be reported to the State by January 11, 1994 and recommendations for optimal treatment are to be provided to the State by July 1, 1994. The detailed time frames for small and medium-size PWSs to comply with the corrosion control and source water treatment requirements of the LCR are presented in Tables 2-2 and 2-3.

The treatment recommendations to be generated include source water and corrosion control treatment components. Upon exceeding an AL during initial monitoring, a small or medium-size PWSs must also monitor lead and copper at each point of entry (POE) to the distribution system to determine whether excessive metals are being contributed by the source water. The POE lead and copper levels must also be reported to the State in conjunction with the system's recommendations for optimal treatment.

The recommendation for optimal treatment (source water and/or corrosion control) may be based on well-documented desk-top evaluations, and need not be determined by demonstration testing of alternative treatment approaches. However, states may require a system to perform such testing, in which case an additional 18 months would be provided to complete the corrosion control study. The requirement to include demonstration testing in the determination of optimal treatment for small and medium-size PWSs does not have to rely on the PWS performing the demonstration testing themselves if a study is underway by another PWS with comparable water quality characteristics.



**REGULATORY REQUIREMENTS FOR STUDIES**

**Table 2-2. Timeline for Small PWSs to Comply with the Corrosion Control and Source Water Treatment Requirements\***

PWS Action	Date	Submission to State
First Six-Month Initial Monitoring Period Results** • Exceed ALs	Jan. 11, 1994	Form 141-A and Monitoring Results: Pb/Cu-TAP; WQP-DIS; WQP-POE
Desk-Top Treatment Evaluation Begins	Jan. 1, 1994	
Source Water Monitoring Results	July 1, 1994	Pb/Cu-POE
Treatment Recommendation	July 1, 1994	Treatment recommendations for corrosion control and/or source water treatment
State Requires Corrosion Studies	Jan. 1, 1995	As necessary, State notifies PWSs required to perform corrosion studies
State Approves/Designates Treatment (No Study)	Jan. 1, 1996	
Corrosion Study and Treatment Recommendation (if Required by State)	July 1, 1996	Treatment Study Report and Results
State Approves/Designates Treatment (with Treatment)	Jan. 1, 1997	
Certification that the State-approved treatment has been installed	Without Study With Study	Letter of Certification Letter of Certification
First Six-Month Follow-Up Monitoring Period Results ***	Without Study With Study	Form 141-A and Monitoring Results: Pb/Cu-TAP; WQP-DIS; WQP-POE Pb/Cu-TAP; WQP-DIS; WQP-POE
Second Six-Month Follow-Up Monitoring Period Results	Without Study With Study	Form 141-A and Monitoring Results: Pb/Cu-TAP; WQP-DIS; WQP-POE Pb/Cu-TAP; WQP-DIS; WQP-POE
State Specifies Optimal Water Quality Parameters	Without Study With Study	Based on Follow-Up Monitoring Results
First Six-Month Monitoring Period Results after State Specifies Optimal WQP — Routine Monitoring	Without Study With Study	Form 141-A and Monitoring Results: Pb/Cu-TAP; WQP-DIS; WQP-POE Pb/Cu-TAP; WQP-DIS; WQP-POE

**REGULATORY REQUIREMENTS FOR STUDIES**

**Table 2-2. Timeline for Small PWSs to Comply with the Corrosion Control and Source Water Treatment Requirements\* (continued)**

PWS Action	Date	Submission to State
Second Six-Month Monitoring Period Results after State Specifies Optimal WQP — Routine Monitoring	Without Study July 11, 2000 With Study July 11, 2001	Form 141-A and Monitoring Results: Pb/Cu-TAP; WQP-DIS; WQP-POE Form 141-B when State-specified WQPs have been maintained for two consecutive six-month monitoring periods
Reduced Monitoring	See Appendix A of Volume I for Dates	Form 141-A and Monitoring Results: Pb/Cu-TAP; WQP-DIS; WQP-POE Form 141-B when State-specified WQPs maintained for three consecutive years under reduced monitoring
Ultimate Reduced Monitoring	See Appendix A of Volume I for Dates	Form 141-A and Monitoring Results Pb/Cu-TAP; WQP-DIS; WQP-POE

Specifically for those small PWSs which exceed the ALs and are required to implement corrosion control treatment and must meet State-specified WQPs.

If a small PWS does not exceed the ALs in the two consecutive monitoring periods, then they may request reduced monitoring (Form 141-B) when submitting results of the second six-month monitoring period. Those systems that meet the ALs are only required to submit Form 141-A and Pb/Cu-TAP monitoring results under reduced monitoring.

✓ \*\* PWSs that meet the ALs in the first six-month round of initial monitoring and fail in the second six-month monitoring period would submit Form 141-A with Pb/Cu-TAP results on January 11, 1993, and submit Form 141-A with Pb/Cu-TAP, WQP-DIS, WQP-POE, Pb/Cu-POE results on July 11, 1993. All other deadlines shown in Table 2-2 should be delayed by six months. 2

PWSs that meet the ALs in the first six-month period and fail to meet the ALs in the second six-month period of the follow-up monitoring only need to submit Pb/Cu-TAP results for the first six-month period of follow-up monitoring.

**REGULATORY REQUIREMENTS FOR STUDIES**

**Table 2-3. Timeline for Medium-Size PWSs to Comply with the Corrosion Control and Source Water Treatment Requirements\***

<b>PWS Action</b>	<b>Date</b>	<b>Submission to State</b>
First Six-Month Initial Monitoring Period Results** • Exceed ALs	Jan. 11, 1993	Form 141-A and Monitoring Results: Pb/Cu-TAP; WQP-DIS; WQP-POE
Desk-Top Treatment Evaluation Begins	Jan. 1, 1993	
Source Water Monitoring Results	July 1, 1993	Pb/Cu-POE
Treatment Recommendation	July 1, 1993	Treatment recommendations for corrosion control and/or source water treatment
State Requires Corrosion Studies	Jan. 1, 1994	As necessary, State notifies PWSs required to perform corrosion studies
State Approves/Designates Treatment (No Study)	July 1, 1994	
Corrosion Study and Treatment Recommendation (if Required by State)	July 1, 1995	Treatment Study Report and Results as Discussed in Volume II
State Approves/Designates Treatment (with Treatment)	Jan. 1, 1996	
Certification that the State-designated treatment has been installed		
Without Study	July 1, 1996	Letter of Certification
With Study	Jan. 1, 1996	Letter of Certification
First Six-Month Follow-Up Monitoring Period Results ***		Form 141-A and Monitoring Results:
Without Study	Jan. 11, 1997	Pb/Cu-TAP; WQP-DIS; WQP-POE
With Study	July 11, 1998	Pb/Cu-TAP; WQP-DIS; WQP-POE
Second Six-Month Follow-Up Monitoring Period Results		Form 141-A and Monitoring Results:
Without Study	July 11, 1997	Pb/Cu-TAP; WQP-DIS; WQP-POE
With Study	Jan. 11, 1999	Pb/Cu-TAP; WQP-DIS; WQP-POE
State Specifies Optimal Water Quality Parameters		Based on Follow-Up Monitoring Results
Without Study	Jan. 1, 1998	
With Study	July 1, 1999	
First Six-Month Monitoring Period Results after State Specifies Optimal WQP — Routine Monitoring		Form 141-A and Monitoring Results:
Without Study	July 11, 1998	Pb/Cu-TAP; WQP-DIS; WQP-POE
With Study	Jan. 11, 2000	Pb/Cu-TAP; WQP-DIS; WQP-POE

## REGULATORY REQUIREMENTS FOR STUDIES

**Table 2-3. Timeline for Medium-Size PWSs to Comply with the Corrosion Control and Source Water Treatment Requirements\* (continued)**

PWS Action	Date	Submission to State
Second Six-Month Monitoring Period Results after State Specifies Optimal WQP — Routine Monitoring <div style="text-align: right; margin-right: 50px;">                         Without Study                          With Study                     </div>	Jan. 11, 1999 July 11, 2000	Form 141-A and Monitoring Results: Pb/Cu-TAP; WQP-DIS; WQP-POE Pb/Cu-TAP; WQP-DIS; WQP-POE Form 141-B when State-specified WQPs have been maintained for two consecutive six-month monitoring periods
Reduced Monitoring	See Appendix A of Volume I for Dates	Form 141-A and Monitoring Results: Pb/Cu-TAP; WQP-DIS; WQP-POE Form 141-B when State-specified WQPs maintained for three consecutive years under reduced monitoring
Ultimate Reduced Monitoring	See Appendix A of Volume I for Dates	Form 141-A and Monitoring Results Pb/Cu-TAP; WQP-DIS; WQP-POE

Specifically for those small PWSs which exceed the ALs and are required to implement corrosion control treatment and must meet State-specified WQPs.

If a small PWS does not exceed the ALs in the two consecutive monitoring periods, then they may request reduced monitoring (Form 141-B) when submitting results of the second six-month monitoring period. Those systems that meet the ALs are only required to submit Form 141-A and Pb/Cu-TAP monitoring results under reduced monitoring.

PWSs that meet the ALs in the first six-month round of initial monitoring and fail in the second six-month monitoring period would submit Form 141-A with Pb/Cu-TAP results on January 11, 1993, and submit Form 141-A with Pb/Cu-TAP, WQP-DIS, WQP-POE, Pb/Cu-POE results on July 11, 1993. All other deadlines shown in Table 2-2 should be delayed by six months.

\*\*\* PWSs that meet the ALs in the first six-month period and fail to meet the ALs in the second six-month period of the follow-up monitoring only need to submit Pb/Cu-TAP results for the first six-month period of follow-up monitoring.

Large PWSs performing demonstration testing, for example, may provide the States and small/medium-size PWSs with relevant experiences and findings for defining optimal corrosion control treatment. Small and medium-size systems that want to incorporate demonstration testing results from another PWS must submit recommendations to the State within six-months of exceeding an AL that includes:

- 1) the rationale supporting the need for additional information to make a final recommendation for corrosion control treatment;
- 2) the identity of the PWS performing demonstration testing;
- 3) the comparability of the small or medium-size PWS's water quality to that of the system performing the demonstration testing;
- 4) the feasibility for the small/medium-size PWS to implement the alternative treatments under investigation in the demonstration testing program; and,
- 5) the small/medium-size PWS's willingness to implement the recommendations resulting from the on-going demonstration testing program.

For those systems performing their own corrosion control demonstration testing program, information is presented in Chapter 4 of this Guidance Manual on how to develop and conduct such a study.

States have six months to review the recommendations of PWSs regarding optimal treatment or the requirement for additional testing, and either approve the selected treatment option or else designate an alternative treatment for installation. PWSs have two years in which to install and start up the approved treatment

alternative on a full-scale basis. At this point, follow-up monitoring is to be performed and compliance with the LCR rests with the ability of the PWS to properly operate the installed treatment.

### ***2.2.2 State Actions and Decisions.***

State activity in implementing the LCR requires decision-making, PWS notification, monitoring and reporting of compliance status, and oversight of PWS actions.

**2.2.2.1 Review of recommended treatment.** Small and medium-size PWSs which submit recommendations for optimal treatment should provide the checklist and Form 141-C for State review. If insufficient information is made available by the PWS, the State may request any additional data necessary to complete the assessment of the recommendations. Twelve months are provided for States to review submittals from medium-size PWSs, and 18 months are provided for small system recommendation review. Acceptance of the recommended treatment may be granted by the State or else optimal treatment must be designated for systems to install.

Small and medium-size systems are not required to conduct demonstration testing (static, flow-through, or full-scale) before making their recommendations for optimal corrosion treatment. However, any PWS that does not conduct a thorough evaluation of its treatment recommendation must realize the risks involved. A desk-top evaluation considers alternatives based on the experience of other PWSs and product manufacturers' recommendations. As each PWS has a unique supply,

## REGULATORY REQUIREMENTS FOR STUDIES

treatment, and distribution system, assurance that the recommended treatment will be effective is lacking without actual demonstration testing. Small and medium-size PWSs may recommend that the findings from a comparable system performing demonstration testing be incorporated into the evaluation of their system; thereby providing an opportunity for these systems to utilize the results of relevant testing programs in the selection of optimal treatment. However, studies which utilize static testing and flow-through testing procedures do not automatically insure that the selected process will provide satisfactory results when implemented full scale. Each PWS must carefully review its individual situation before deciding which approach is most appropriate for its particular set of circumstances.

In reviewing the submittals, several features of the checklist and Form 141-C may assist the States in determining the appropriateness of the recommended treatment. Namely,

- Completeness of the information provided;
- Supporting documentation regarding the experiences of the PWS or other, comparable PWSs with alternative corrosion control treatment approaches;
- Consistency with the desk-top evaluation procedures described in the Guidance Manual; and,
- Evidence of the PWS's general understanding of the alternative treatment methods and their application.

A primary concern for States will be the appropriate use of treatment products in order that successful corrosion control

programs may be implemented by small and medium-size PWSs.

**2.2.2.2 Requirement for additional study.** PWSs are to be notified within six months of submitting recommendations for optimal treatment that a corrosion control study is required by the State. Certain small or medium-size PWSs may desire to perform corrosion control studies in order to more fully evaluate the alternative treatment processes. If this is the case, then these PWSs should submit recommendations for the alternatives to be included in the demonstration testing to the State within six months of exceeding the AL in lieu of recommendations for optimal treatment. This will provide an additional six-month period for performing the demonstration study. Those systems wishing to incorporate the findings of a comparable system performing demonstration testing should include the five items presented in Section 2.2.1 in their submittal to the State. If the State approves this recommendation, the PWS would have an additional 18-months to present final recommendations for optimal treatment, documenting the incorporation of the findings from the demonstration testing performed by the relevant system.

**2.2.2.3 Designating alternative treatment.** States have the authority to designate treatment for small and medium-size PWSs which have exceeded the ALs and submitted recommendations for optimal treatment. However, it is recommended that States and PWSs mutually determine optimal treatment in cases where the recommended approach appears to be questionable by the State. Additionally, States could require demonstration

## REGULATORY REQUIREMENTS FOR STUDIES

testing when significant uncertainty regarding the performance of alternative treatments cannot be resolved through other means.

### 2.2.2.4 Notification requirements.

States have several notification steps relevant for small and medium-size PWSs exceeding ALs during initial monitoring. The dates and types of notification must be issued by States as part of the treatment requirements for the LCR are

presented in Table 2-4 for the case where an AL is exceeded during the first six-month period of initial monitoring.

### 2.3 References

USEPA. 1991. Technologies and Costs for the Removal of Lead and Copper from Potable Water Sources. Office of Ground Water and Drinking Water. (Washington, D.C.).

**Table 2-4. Dates for State Notification\***

Notification Action	Small PWSs	Medium-size PWSs
Requirement for Corrosion Control Studies	January 1995	January 1994
Source Water Treatment Approval/Disapproval	January 1995	January 1994
Corrosion Control Treatment Approval/Designation	July 1996	January 1995 <i>July ?</i>

\* These dates are based on the assumption that the water system exceeded an action level in the first six-month period of the initial monitoring. For those small and medium-size systems that meet the ALs in the first six-month period and fail in the second six-month period, the dates would be delayed by six months.