Appendix C

Chapter 4 Lead/Copper Rule
Interpreting Results – Invalidation of Results

- Determining the 90th percentile *(Pg. C-2)*
- Calculating the 90th percentile blank worksheet with instructions *(Pg. C-4)*
- Invalidation of Results *(Pg. C-7)*

Interpreting Results

Lead and copper analytical results are evaluated against an action level (AL), not an MCL. The lead AL is exceeded if the concentration of lead in more than 10 percent of tap water samples collected during any monitoring period is greater than 0.015 mg/L (i.e., if the 90th percentile level lead level is greater than 0.015 mg/L). The copper AL is exceeded if the concentration of copper in more than 10 percent of tap water samples collected during any monitoring period conducted is greater than 1.3 mg/L (i.e., if the 90th percentile copper level is greater than 1.3 mg/L). All samples that meet the proper site selection and sample collection procedures are used to determine the 90th percentile calculation, even if you collect samples from more sites than required.

It is strongly recommended that results are evaluated by the CWS as they are received from the laboratory. If the CWS waits until after the end of the monitoring period to evaluate the results, then this will reduce the number of options the CWS will have for the next course of action should results indicate an AL exceedance (such as collection of additional samples). It is suggested the CWS contact the Lead / Copper Rule Coordinator at 217-785-0561 to discuss options as soon as results indicate an AL exceedance.

The 90th percentile is calculated separately for lead and copper. The procedure for determining the lead 90th percentile value is as follows:

If you are required to collect more than five samples:

Step 1: Place lead results in ascending order (from lowest to highest value).

Step 2: Assign each sample a number, 1 for lowest value.

Step 3: Multiply the total number of samples by 0.9.

Step 4: Compare the answer to Step 3, the 90th percentile level, to the action level of 0.015 mg/L (can also be expressed as 15 parts per billion (ppb)). If your 90th percentile value is higher than 0.015 mg/L, you have an exceedance.

Repeat this procedure for copper sample results, except compare the 90th percentile copper level against its action level of 1.3 mg/L. If your 90th percentile value is greater than 1.3 mg/L, you have an exceedance. See Pages C-4 through C-6 for more detailed instructions.

If you are required to collect five samples:

Step 1: Place lead or copper results in ascending order.

Step 2: Take the average of the 4th and 5th highest sample. This is your 90th percentile level.

Step 3: Compare the 90th percentile level against the lead or copper action level.

The next page is two examples to help demonstrate the 90th percentile calculation for systems that are required to collect more than five samples. The first example explains how to determine whether you have exceeded an action level when your 90th percentile level is a whole number. The second example shows how to make this determination using interpolation when your 90th percentile level contains a decimal. This may happen when you collect more than the minimum required number of samples.

In **Example 1**, a system serving 150 people is on initial monitoring, and collects the minimum number of required samples for its size category (i.e., 10 samples). The 90th percentile level corresponds to the 9th highest sample (i.e., 10 samples x 0.9). It does not exceed the lead action level because its 90th percentile level is 0.015 mg/L, which equals the lead action level. To have an exceedance, the 90th percentile level must be greater than 0.015 mg/L.

In **Example 2**, the system is required to collect a minimum of 10 valid samples. It collects 12 valid samples and thus, all 12 are used in the 90th percentile calculation. The 90th percentile level is 10.8 (i.e., 12 samples x 0.9 = 10.8). Interpolation can be used to determine the 90th percentile level when the sample that represents it is not a whole number (see explanation below).

Example I: 90th Percentile Is a Whole Number

Sample Rank	Sample Value
1	0.000
2	0.000
3	0.002
4	0.005
5	0.005
6	0.006
7	0.006
8	0.010
9 (90th percentile)	0.015
10	0.020

Example 2: 90th Percentile Contains a Decimal

Sample Rank	Sample Value
1	0.000
2	0.000
3	0.002
4	0.005
5	0.005
6	0.005
7	0.006
8	0.006
9	0.010
10	0.014
10.8 (90th percentile)	
11	0.018
12	0.020

Using Interpolation: To determine the 90th percentile level, using interpolation, you would:

1. Subtract the difference of the two samples between which your 90th percentile falls. In this example you would subtract the 10th sample result of 0.014 mg/L from the 11th sample result of 0.018 mg/L, for a difference of 0.004 mg/L.
2. Subtract the difference between the 90th percentile level of 10.8 and the lower of the two sample rankings between which the 90th percentile level falls or 10, for a difference of 0.8.
3. Multiply the difference of 0.004 mg/L (from Step 2) by 0.8 (from Step 3): 0.004 x 0.8 = 0.0032 mg/L (or 0.003 when rounded to the number of significant figures).
4. Add 0.003 to the lower of the two sample results, in this example to the 10th sample result of 0.014 mg/L: 0.003 + 0.014 = 0.017 mg/L.

Thus, the 90th percentile lead level is 0.017 mg/L and the system exceeds the lead action level.

1. Using the chart on paged C-5 and C-6, fill in the facility number, facility name and six-month monitoring compliance period for the samples.

2. List the lead results on one form and the copper results on another form. Circle the appropriate metal on the top of the chart. (No lead or copper to circle on form????)

3. All sample results must be listed, those analyzed by the Illinois EPA laboratory, those analyzed by certified laboratories, those listed on the lead/copper site plan, any additional samples collected beyond the required number, and any repeat samples.

4. List the results in ascending order (least to greatest) with the corresponding sample site number. If there is no site number, for additional samples collected beyond the required number, list an address.

5. If there are more than 100 samples, use an additional page for listing the results and change the ranking number (i.e. 1 to 101, 2 to 102, etc.).

6. Complete the calculation portion of the form.

    A. Multiply the number of samples time 0.9. Write the answer on line A.

    B. If this is a whole number (i.e. 3, 120), write the result for this number on line H after the equal sign. You are done!

    C. If this is not a whole number (i.e. 3.5, 112.3), list the ninetieth percentile sample number on line C.

    D. List the sample number of the next lower whole number on line B with its result and list the sample number of the next higher whole number on line D with its result.

    E. Subtract the sample number on line B from the ninetieth percentile sample number on line C, this is the interpolation factor. Write the answer on line E.

    F. Subtract the result of the next lower sample on line B from the result for the next higher sample on line D. Write the answer on line F.

    G. Multiply the interpolation factor, line E, times the difference in the sample results, line F. Write the answer on line G.

Add the interpolated result, line G, to the result for the next lower sample, line B. This is the ninetieth percentile result, write it on line H.

Calculation of Ninetieth Percentile

Facility No. _____ Compliance Period: _____

Facility Name: _____

	Site Number	Result (ug/l)			Site Number	Result (ug/l)
1.				37.		
2.				38.		
3.				39.		
4.				40.		
5.				41.		
6.				42.		
7.				43.		
8.				44.		
9.				45.		
10.				46.		
11.				47.		
12.				48.		
13.				49.		
14.				50.		
15.				51.		
16.				52.		
17.				53.		
18.				54.		
19.				55.		
20.				56.		
21.				57.		
22.				58.		
23.				59.		
24.				60.		
25.				61.		
26.				62.		
27.				63.		
28.				64.		
29.				65.		
30.				66.		
31.				67.		
32.				68.		
33.				69.		
34.				70.		
35.				71.		
36.				72.		

Calculation of Ninetieth Percentile

Facility No. _____ Compliance Period: _____

Facility Name: _____

	Site Number	Result (ug/l)			Site Number	Result (ug/l)
73.				87.		
74.				88.		
75.				89.		
76.				90.		
77.				91.		
78.				92.		
79.				93.		
80.				94.		
81.				95.		
82.				96.		
83.				97.		
84.				98.		
85.				99.		
86.				100.		

If more than 100 samples are collected, list samples on a second form and calculate ninetieth percentile on that form.

A. (number of samples) X (0.9) = 90th percentile sample
_____ X (0.9) = _____

B. Next lower sample no. _____ Result _____

C. 90th percentile sample no. _____ Result _____

D. Next higher sample no. _____ Result _____

E. Line C – Line B sample no. _____ = Interpolation Factor

F. Line D result - Line B result Result _____

G. (Line E factor) X (Line F result) = _____

H. Line G result + Line B result = interpolated 90th percentile
_____ + _____ = _____

Instructions of Calculation of Ninetieth Percentile

7. Fill in the facility number, facility name and six-month monitoring compliance period for the samples.

8. List the lead results on one form and the copper results on another form. Circle the appropriate metal on the top of the chart.

9. All sample results must be listed, those analyzed by the Illinois EPA laboratory, those analyzed by certified laboratories, those listed on the lead/copper site plan, any additional samples collected beyond the required number, and any repeat samples.

10. List the results in ascending order (least to greatest) with the corresponding sample site number. If there is no site number, for additional samples collected beyond the required number, list an address.

11. If there are more than 100 samples, use an additional page for listing the results and change the ranking number (i.e. 1 to 101, 2 to 102, etc.).

12. Complete the calculation portion of the form.

    H. Multiply the number of samples time 0.9. Write the answer on line A.

    I. If this is a whole number (i.e. 3, 120), write the result for this number on line H after the equal sign. You are done!

    J. If this is not a whole number (i.e. 3.5, 112.3), list the ninetieth percentile sample number on line C.

    K. List the sample number of the next lower whole number on line B with its result and list the sample number of the next higher whole number on line D with its result.

    L. Subtract the sample number on line B from the ninetieth percentile sample number on line C, this is the interpolation factor. Write the answer on line E.

    M. Subtract the result of the next lower sample on line B from the result for the next higher sample on line D. Write the answer on line F.

    N. Multiply the interpolation factor, line E, times the difference in the sample results, line F. Write the answer on line G.

    O. Add the interpolated result, line G, to the result for the next lower sample, line B. This is the ninetieth percentile result, write it on line H.

Invalidation of Results

The Illinois EPA can invalidate a lead or copper tap water sample if any one of the following is true:

1. The laboratory establishes that improper analysis caused errors;
2. The Illinois EPA determines that the sample site did not meet the site selection criteria;
3. The sample container was damaged in transit; or
4. Substantial reason exists to believe that the sample was tampered with.

For the Illinois EPA to make this determination, you must provide them with all sample results and documentation of the reasons that the samples should be invalidated. **Samples may not be invalidated solely on the grounds that a follow-up sample result is higher or lower than the original sample.**

Replacement Samples: If the Illinois EPA invalidates your sample(s), you only need to collect a replacement sample if the number of valid samples is below the minimum number of required samples. For example, assume you are on routine monitoring and only collect the required number of samples (use 40 as an example). If one of these samples is invalidated, you only have 39 valid samples, and therefore, must collect 1 replacement sample. Conversely, if you initially collected 41 samples and 1 was invalidated, you would still have 40 valid samples and would not need to collect a replacement sample.

Replacement samples must be taken as soon as possible, but must be taken within 20 days of the date of invalidation, or by the end of the applicable monitoring period, whichever is later. If these samples are taken after the end of the applicable monitoring period, they cannot be used to fulfill the sampling requirements of a subsequent period. For example, assume a system is on a six-month monitoring schedule. It collects a replacement sample in July 2009 for one invalidated sample that was collected during the January through June 2009 monitoring period. It cannot include this replacement sample as part of its samples for the July through December 2009 monitoring period.

Please note that you may find yourself in a situation where the State invalidates your sample(s) on a date that does not allow you to collect a replacement sample during the months in which you are required to conduct monitoring (i.e., June through September or an alternate period designated by the State). In this event, you can collect this sample outside this time period, as long as you collect the sample(s) no later than 20 days after the date the sample(s) was(were) invalidated. For example, assume you are required to conduct monitoring during June through September and the State invalidates one of your samples on October 15, 2009. You have until November 4, 2009 (i.e., 20 days after the State's invalidation decision) to collect the replacement sample.