

## **Chlorine Analyzer Startup Following U.S. EPA Method 334.0 For Drinking Water Utilities**

The U.S. EPA published method 334.0 "Determination of Residual Chlorine in Drinking Water Using An On-Line Chlorine Analyzer" in November 2009. The method specifies the procedures for determining free or total chlorine residuals in drinking water and is primarily intended to be used by drinking water utilities for compliance with daily monitoring requirements if required to do so by the EPA Groundwater Rule.

Although intended for drinking water, the method provides a good basic framework to achieve reliable chlorine residual measurements in any application.

For required drinking water customers, a brief outline of the steps to install, startup and maintain each chlorine analyzer follows. Please refer to EPA Method 334.0 for detailed instructions and requirements.

1. Select an approved grab sample instrument such as a DPD colorimeter or amperometric titrator.
2. Verify the calibration accuracy of each grab sample instrument that will be used to calibrate and verify the chlorine analyzer.
3. Verify the accuracy of secondary test standards for each colorimeter to be used.
4. Each field sampler (operator) must complete an initial demonstration of capability (IDC) prior to using the grab method in conjunction with an on-line chlorine analyzer.
5. Install the analyzer per manufacturer instructions.
6. After the analyzer is providing stable readings, calibrate and verify the instrument using the selected grab sample method. The readings must be within  $\pm 0.1$  mg/L or  $\pm 15\%$  of the grab sample measurement.
7. After the calibration and accuracy of the analyzer is verified, perform an initial demonstration of capability (IDC) by comparing the analyzer's readings with grab sample analysis at least daily for 14 days. The readings must be within  $\pm 0.1$  mg/L or  $\pm 15\%$  of the grab sample measurement. The data collected must be recorded and maintained.
8. Upon successful completion of the IDC, the analyzer can be put into service for compliance monitoring.
9. Perform routine grab sample comparisons. The maximum time between grab samples must not exceed once every seven days.
10. After routine maintenance is performed, the accuracy of the analyzer must be verified with a grab sample comparison after the analyzer is placed back into service. The accuracy must be verified again after one day of operation.

A summary of the required procedures for startup and ongoing operation as copied from method 334.0 follows. A copy of the method in its entirety is available from [www.foxcroft.com](http://www.foxcroft.com) and from the EPA web page: [http://epa.gov/safewater/methods/pdfs/methods/met334\\_0.pdf](http://epa.gov/safewater/methods/pdfs/methods/met334_0.pdf).

**Table 1. Summary of Start-up QC for Grab Sample Methodology**

Method Reference	Requirement	Specification	Acceptance Criteria
10.1.1.2	Generate or validate calibration curve	Analyze method blank & 3 calibration standards that span concentration range (Lowest standard $\leq$ 0.2 mg/L or the minimum required by primacy agency.)	Each standard is within $\pm 15\%$ of its expected concentration when compared to curve
10.1.1.3	Verify accuracy of secondary standards	Analyze secondary standards on each meter for which they will be used.	Each secondary standard is within $\pm 10\%$ of its expected concentration
10.1.2.1	Initial Demonstration of Capability (IDC) - Accuracy	Analyze method blank & 5 replicate independent reference samples fortified at a concentration near the drinking water concentration	Method blank $\leq \frac{1}{3}$ concentration of lowest calibration standard; Average of 5 replicates is within $\pm 15\%$ of expected concentration
10.1.2.2	Initial Demonstration of Capability (IDC) - Precision	Calculate relative standard deviation (RSD) for 5 independent reference sample replicate analyses	RSD $\leq 15\%$
10.1.3	Field Sampler IDC	Each sampler must successfully complete 10.1.2.1 and 10.1.2.2 (IDC samples may be prepared by laboratory personnel for analyses by field samplers.)	

**Table 2. Summary of Start-up QC for On-line Chlorine Analyzer**

Method Reference	Requirement	Specification and Frequency	Acceptance Criteria
10.2.1	Verify or adjust analyzer calibration	Analyze grab sample & compare to analyzer reading; Adjust analyzer to agree with grab sample measurement; Iterative process until agreement is reached	Analyzer reading is within $\pm 0.1$ mg/L or $\pm 15\%$ (whichever is larger) of grab sample measurement
10.2.2	Initial Demonstration of Capability (IDC)	Compare analyzer measurement to a grab sample analysis on a daily basis for 14 consecutive days (or business days)	Analyzer reading must be within $\pm 0.1$ mg/L or $\pm 15\%$ (whichever is larger) of the grab sample measurement for each data pair

**Table 3. Routine QC for Grab Sample Methodology**

Method Reference	Requirement	Specification and Frequency	Acceptance Criteria
11.1.1	Routine calibration check	Analyze a check standard: <ul style="list-style-type: none"> <li>• When calibration of the on-line chlorine analyzer is adjusted</li> <li>• At least quarterly</li> </ul>	Standard is within $\pm 15\%$ of its expected concentration
11.1.2	Secondary standards	Recommended: analyze each day grab sample method is used (This is only applicable to methods that use a spectrophotometer/colorimeter.)	Each secondary standard is within $\pm 10\%$ of its expected concentration

**Table 4. QC for On-line Chlorine Analyzer**

Method Reference	Requirement	Specification and Frequency	Acceptance Criteria
11.2	Routine calibration check	Compare analyzer measurement to a grab sample analysis: <ul style="list-style-type: none"> <li>• on a routine basis (at least once each week)</li> <li>• immediately after analyzer calibration is adjusted</li> <li>• one day after analyzer calibration is adjusted</li> </ul>	Analyzer reading must be within $\pm 0.1$ mg/L or $\pm 15\%$ (whichever is larger) of the grab sample measurement
11.3	Non-routine calibration check	Compare analyzer measurement to a grab sample analysis: <ul style="list-style-type: none"> <li>• after routine maintenance</li> <li>• when analyzer drifts upward or downward without explanation (recommended)</li> </ul>	Analyzer reading must be within $\pm 0.1$ mg/L or $\pm 15\%$ (whichever is larger) of the grab sample measurement
11.4	Emergency calibration check	If the analyzer indicates a large ( $\geq 50\%$ ) unexpected change in chlorine residual, compare analyzer measurement to a grab sample analysis as soon as possible	Analyzer reading must be within $\pm 0.1$ mg/L or $\pm 15\%$ (whichever is larger) of the grab sample measurement