

Performance Qualification Guideline for Total Organic Carbon (TOC) Determination in Drinking Water

Sievers 900 and 5310 C Series TOC Instruments

The EPA requires drinking water laboratories that are certified for TOC reporting to take specific actions ensuring quality data is generated and accurately reported. The following performance qualification guidelines were formulated based on EPA 415.3 and SM 5310 C. Laboratories should work with their local regulator to ensure their standard operating procedure meets the local guideline.

Please note GE Analytical Instruments recommends running each vial within this protocol with at least four repetitions and one reject.

Initial Set-up of a Sievers TOC Instrument

The following steps should be taken for instrument start-up or recalibration.

1. Initial Demonstration of Low System Background

Run a laboratory reagent blank. Ensure that a clean 40-mL vial is used to minimize introducing background organics to the blank. The blank must read ≤ 350 -ppb TOC.

2. Initial Instrument Calibration Verification

The instrument is factory calibrated using a multi-point calibration and does not need to be recalibrated upon start-up. The calibration is stable up to one year. When

- 900 Series and 5310 C (V1.3 and earlier): 1-, 5-, 10-, 25-, 50-ppm standards (GE P/N CSTD 90000-01)* or
- 5310 C Series (V1.4 and later): 0.25-, 1-, 5-, 25-, 50-ppm standards (GE P/N CSTD 96000-01)*

*Sets include TOC, IC and blank standards

recalibrating use the standards shown in the previous box.

Verify the calibration accuracy using a single-point calibration verification procedure described in the instrument manual. Verification can be performed at 1-, 2-, and 5-ppm TOC.



- 1-ppm Verification Set: GE P/N CSTD 90008-01*
- 2-ppm Verification Set: GE P/N CSTD 90009-01*
- 5-ppm Verification Set: GE P/N CSTD 90010-01*

*Sets include TOC, IC, and blank standard

3. Initial TOC Flow Injection Memory Check or Carry-Over

Run a 50-ppm TOC standard followed by two lab reagent blanks. If the first lab reagent blank is ≥ 350 ppb TOC and the second blank is ≤ 350 ppb TOC, a memory or carry-over problem is indicated. The Sievers TOC instruments perform an 8-minute fast flush at the start of each vial to avoid this. The EPA Method states a blank can be used after every sample, to allow an extended rinse down, if this problem is detected.

Note: Lab reagent water should ideally be below 100 ppb for blanks and standards used in all protocols. GE Analytical Instruments' standards are manufactured with less than 20-ppb water.

4. Inorganic Carbon (IC) Removal Efficiency Test

Ensure that the inorganic carbon removal (ICR) module's switch is in the inline position for operation. Run



a 100-ppm IC standard made with low TOC lab reagent water. The sample must read ≤ 350 ppb TOC.

5. Initial Demonstration of Accuracy

Run five standards at one concentration of 1-, 2-, or 5-ppm TOC. The average readings between the five samples must be within $\pm 20\%$ of the true value.

6. Initial Demonstration of Precision

The relative standard deviation (RSD) of the five standards from the accuracy test (see #5) must be $\leq 20\%$.

7. Total Organic Carbon Detection Limit (OCDL) Determination

This test is conducted over at least three days, with a minimum of seven replicate analyses run each day. A 1-ppm TOC standard is used to estimate the starting concentration for the study. If the instrument measures the 1-ppm TOC standard within $\pm 20\%$ of the TOC value and a RSD $\leq 20\%$, the analyst should lower the concentration of the standard to 500 ppb. The same is repeated for the 500-ppb TOC standard. The OCDL calculation should be carried out according to Standard Method 1050B. If the OCDL exceeds 350 ppb or the mean recovery of the standard used in the OCDL determination exceeds $\pm 50\%$ of the true value, repeat this step.

Continuing Checks

The following steps should be performed with each analysis batch, daily, or as frequently as approved by the local regulatory authority.

1. Calibration Check

Run a 500-ppb or 1-ppm TOC standard prior to TOC analysis. This will signify the low-range calibration check. Subsequent calibration checks are analyzed after every ten samples and after the last sample.

The concentrations should be rotated to cover the instrument calibration range. Again the low range of 500-

Municipal TOC Set: 1-, 5-, 10-ppm TOC standards (no blank) GE P/N CSTD 90031

ppb or 1-ppm TOC should be used. A mid range of 2- or 5-ppm TOC standard and a high range of 10-, 25- or 50-ppm TOC is also used.

Acceptance criteria are as follows:

- Low range: $\pm 50\%$ true value
- Mid range: $\pm 20\%$ true value
- High range: $\pm 15\%$ true value

2. Field Duplicate

A minimum of one set of field duplicates should be analyzed. Two samples are collected at the field site and are treated exactly alike. EPA Method 415.3 recommends the field samples be greater than 2 ppm TOC.

Calculate the relative percent difference (RPD) for the two field duplicates (FD1 and FD2):

$$RPD = \frac{(FD1-FD2)}{(FD1+FD2)/2} * 100$$

The relative percent difference for the two field duplicates should be $\leq 20\%$ RPD.

3. Laboratory Fortified Matrix (LFM) Check

An aliquot of one field sample is fortified with KHP to increase the sample to 500–200% of the expected concentration.

Calculate the percent spike recovery using the following equation:

$$\%REC = \frac{(A-B)}{C} * 100$$

Where:

- A = measured concentration of fortified sample
- B = measured concentration in unfortified sample
- C = fortification concentration

The LFM recovery should fall within 70%–130%.

4. Laboratory Reagent Blank

Within each analysis batch, a minimum of one lab reagent blank must be analyzed. This must be measured as ≤ 350 ppb TOC.

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300 00201 Rev A
MC08-223