DWR–NPDES–SOP–G–09-Total Dissolved Solids 2540 C-01012024
Total Dissolved Solids (TDS), SM 2540 C-2015

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1) **EFFECTIVE DATE: 01/01/2024**

2) **SIGNATURES:**

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Total Dissolved Solids (a.k.a. Filterable Residue)

Initial Demonstration of Capability (DOC)

- 2020 B.1.a. - each analyst must run a known standard concentration at least four times and compare limits listed in the method (under Precision). Table 2020:II lists method blanks (MB), laboratory-fortified blanks (LFB), and duplicates for QC
- **Summary: *each* operator running this test needs to analyze four samples of a TDS Standard with acceptable recoveries**
    - **Keep a folder for each analyst**
    - **Keep documentation (signed form) that analyst has read and understands all appropriate SOPs and Methods**
    - **A backup analyst should conduct a DOC once a year**

Method Detection Limit (MDL)

- NONE

Initial Calibration Verification (ICV)

- 2020 B.2.a.– check instrument balance daily as stated below
- 9020.B.4.b. Service balances annually or more often as conditions change or problems occur
    - Check balance routinely, preferably daily before use, with at least two working weights that bracket the normal usage range. [e.g., ANSI/ASTM Class 1, 2, or 3 or NIST Class S (redefined as ASTM Class 1 weights and no longer available), accompanied by appropriate certificate] for accuracy, precision, and linearity. Record results along with date and technician's initials
    - Recertify reference weights as specified in the certificate of calibration or at least every 5 years
- 2540 B.2. analytical balance, capable of weighing to 0.1 mg
- **Summary: check balance *daily* *(day of)* with at least two working weights that bracket the normal usage range. Record results on bench sheet or separate log book**

Method Blank (MB)

- 2020 B.2.d.– include at least 1 method blank (MB) daily or with each batch of 20 or fewer samples, whichever is more frequent
- 2540 A.5. – Analyze one method blank (MB) per batch of 20 samples for each method except settleable solids (2540F). Blank analysis includes all container- and filter-preparation steps and procedures except sample addition
- **Summary: on a 5% basis (see batch size for more information) filter 100 mL of distilled water and analyze as a sample**

Laboratory Fortified Blank (LFB)

- 1020 B.6.– A laboratory-fortified blank is a reagent water sample to which a known concentration of the analyte of interest has been added
    - Sample batch = 5% basis
- 2020 B.2.e. – Using stock solutions, prepare fortified concentrations so they are within the calibration curve
- 2540 A.5. – Include one laboratory-fortified blank (LFB) per batch of 20 samples. Plot the percent recoveries on a control chart for laboratory evaluation. Laboratories may purchase known standards or prepare in-house working controls for use
- 2540 C.1. – To meet the LFB requirement (2540A.5), analysts can create a TDS standard as follows: Dry NaCl at 103-105°C for ≥ 1 h, weigh 50 mg, and dilute to 1 L with reagent water. This results in a 50-mg/L TDS standard
- **Summary: analyze a TDS Standard**
    - **Run on a 5% basis (see batch size for more information)**
    - **Plot percent recoveries on a control chart**

Procedure to Omit Re-drying/Re-cooling/Re-weighing Cycle

How to acquire acceptable results for the total dissolved solids comparability data:

- The maximum holding time for a total dissolved solids sample prior to analysis is 7 days if stored at temperatures of 6˚C and below (not 0˚C). (40 C.F.R part 136, Table II)
- EPA recommends that 4-7 different samples, in duplicate, be collected and analyzed for this procedure in order to prove that the step for "reheating, recooling, and reweighing" is unnecessary. "Different" could mean samples collected 4-7 consecutive days or 4-7 samples run in one day. These 4-7 samples are dried ***overnight*** at 180 ± 2°C.
- The next morning, the evaporating dishes are removed from the oven, allowed to cool in the desiccator and weighed.
- The samples are then returned to the drying oven for one hour, recooled and reweighed.
- The resulting data should be examined to determine if the difference between the overnight values and the redried values are less 0.5 mg. If so, the redrying step may be omitted for a normal set of samples.
- This procedure excludes atypical samples. (i.e., high fat, oil and grease samples).
- The operator may choose not to perform this study and continue to follow the procedure for redrying/recooling/reweighing cycle as stated the method (SM 2540 C.3.d.).

The study should be re-evaluated at least once per year or whenever a change in sample characteristics occurs and kept on file at the treatment plant.

Duplicate

- 1020 B.8. states as a minimum to include one duplicate sample with each sample set or on a 5% basis whichever is more frequent
- 2020 B.2.f. states to include at least one duplicate for each matrix type daily or with each batch of 20 or fewer samples
- 2540 A.5. - Analyze ≥ 5% of all samples in duplicate or at least one duplicate sample with each batch of ≤ 20 samples
- Typically, the relative percent difference (RPD) of duplicates should not exceed 10%, but RPDs may vary considerably due to sample matrix and concentration
- 2540 A.2. - Dry samples to constant weight if possible; this entails multiple cycles of drying, cooling, and weighing for each sample
- **Summary: Analyze two samples for TDS**
    - **For example, filter 100 mL of effluent through filter pad A then filter another 100 mL of effluent through filter pad B. Transfer filtrate to evaporating dish, evaporate, dry, cool, and weigh. Figure RPD for both samples**
    - **Target value should be close to the first value and have a small RPD (less than 10%, target 5% or less)**
    - **Analyze a duplicate at a 5% rate (see batch size for more information)**
- **For reporting purposes, average sample and duplicate**
- **A precision control chart is required for duplicates (see control chart section below for more information)**

Laboratory Fortified Matrix (LFM)/Laboratory Fortified Matrix Duplicate (LFMD)

- NONE

Control Charts

- 1020 B.13.a. – The accuracy chart for QC samples… is constructed from the average and standard deviation of a specified number of measurements of the analyte of interest… The accuracy chart includes upper and lower warning levels (WLs) and upper and lower control levels (CLs). Common practice is to use ±2*s* and ±3*s* limits for the WL and CL, respectively, where *s* represents standard deviation
- 1020 B.13.b. – The precision chart also is constructed from the average and standard deviation of a specified number of measurements [e.g., %RSD or relative percent difference (RPD)] for replicate or duplicate analyses of the analyte of interest. Perfect agreement between replicates or duplicates results in a difference of zero when the values are subtracted, so the baseline of the chart is zero. Therefore, for precision charts, only upper WLs and upper CLs are meaningful
- **Summary: Create and maintain control charts once you have 20-30 data points**

Corrective Action - 1020 B.5., B.8., & B.15.

QC Acceptance Criteria

- Blanks < 2.5 mg/L
- LFB ± 15%
- RPD ± 10% (Target ± 5%)

Batch Size

- *Influent and Effluent are 2 different samples*
- For samples that need to be analyzed on a 5% basis or once for every 20 samples follow these criteria:
    - If a permit stated that 3 analyses per week, that would be 6 samples per week, we would allow for a blank and LFB to be analyzed at least twice a month
        - Pick a date and be consistent, the 1st and 15th of every month or the 1st and 3rd Thursday of every month. Mark your calendar!!
    - If a permit stated 5 analyses per week, that would be 10 samples per week, we would allow once a week
        - Pick a date and be consistent, every Monday. Mark your calendar!!
- For samples that need to be analyzed on a 10% basis or once for every 10 samples follow these criteria:
    - If a permit stated that 3 analyses per week, that would be 6 samples per week, we would allow for a duplicate to be analyzed at least twice a month
        - Pick a date and be consistent, the 1st and 15th of every month or the 1st and 3rd Thursday of every month. Mark your calendar!!
    - If a permit stated 5 analyses per week, that would be 10 samples per week, we would allow once a week
        - Pick a date and be consistent, every Monday. Mark your calendar!!

Calculations

- % Recovery for LFB =

$$\left(\frac{LFB\ concentration}{expected\ concentration}\right)\text{X100}$$

- RPD – relative percent differences for duplicates and LFM/LFMD =

$$\left(\frac{|sample\ result\ -\ duplicate\ result|}{(sample\ result + duplicate\ result)/2}\right)\text{x100}$$

Revision Number	Date	Brief Summary of Change
0	February 2016	Initial issuance of the Guidance
1	December 15, 2021	Method editorial revision date changed from 2011 to 2015, duplicate information added from SM 2540 (2015), added information on control charts.
2	December 11, 2023	Grammatical and word choice changes, effective date