

ANATEL PAT700 ON-LINE TOC ANALYZER STANDARD OPERATING PROCEDURES



EXCELLENCE IN PROCESS ANALYTICS

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1 Anatel PAT700 TOC Analyzer Standard Operating Procedures

Table 1-1 : Revision History

Revision	Date	Comments
01	November 2007	Initial Release.

This document contains the following Anatel PAT700 TOC Analyzer Standard Operating Procedures (SOPs):

Table 1-2 : SOP Contents

SOP	Title	Revision	Release
700-1	Calibration of the PAT700 TOC Analyzer	1.0	11/07
700-2	Validation of the PAT700 TOC Analyzer	1.0	11/07
700-3	System Suitability of the PAT700 TOC Analyzer	1.0	11/07
700-4	Conductivity Calibration of the PAT700 TOC Analyzer	1.0	11/07

STANDARD OPERATING PROCEDURE

SOP Number: 700-1

Replaces Revision: Initial 1.0
Release

Calibration of the Anatel PAT700 TOC Analyzer

Objective

Calibration provides a confirmation of the accuracy of the TOC values obtained by Anatel online Total Organic Carbon instrumentation. TOC values are determined by measuring the change in conductivity of a high-purity water sample as its organic compounds are oxidized to carbon dioxide inside the instrument's analysis cell. The confirmation procedure subtracts the average of a series of background TOC measurements from the average of a series of user-selected standard measurements (in the form of sucrose). Linear regression is performed on the data and the correlation coefficient (R2) and percent slope change (%SC) is calculated. The calculated R2 value is recommended to be ≥ 0.990 and $\leq 15\%$ of the factory calibration.

Note: This Standard Operating Procedure does not attempt to address safety issues associated with its performance. It is the user's responsibility to establish appropriate safety and health practices, as well as determine the applicability of any pertinent regulatory restrictions prior to use.

Distribution List:

- _____
- _____
- _____
- _____
- _____
- _____

Approved by:

Reviewed by:

Effective date:



EXCELLENCE IN PROCESS ANALYTICS

1 Frequency

Calibration of the PAT 700 TOC Analyzer should be performed routinely according to industry regulations or company protocol thereafter.

2 Scope

This procedure is specific for the TOC Calibration of the Anatel TOC Analyzer, models PAT700100, PAT700200, PAT700300, PAT700400 and PAT700500.

3 Reference Documents

- Operator Manual - PAT700 (P/N: FG7005002)
- "<643> Total Organic Carbon," United States Pharmacopeia National Formulary USP 31-NF 26, November 2007
- ISO method 8245 "Guidelines for the Determination of Total Organic Carbon."

4 Materials, Apparatus, and Chemicals

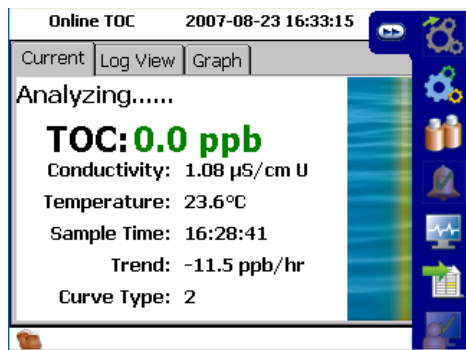
Anatel PAT700 Calibration Kit (P/N: FG7019202), including the following:

- One (1) Vial of Reagent Water Blank
- One (1) Vial of 250 ppb C Sucrose Standard
- One (1) Vial of 500 ppb C Sucrose Standard
- One (1) Vial of 750 ppb C Sucrose Standard

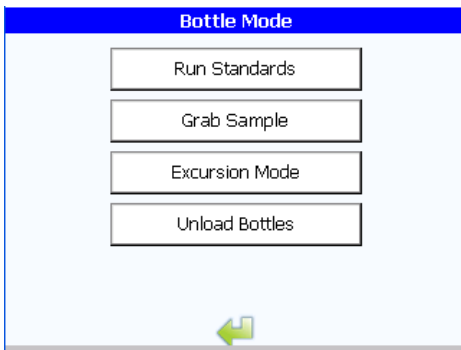
The Kit is valid for 30 days from the date of shipment and should be stored in a refrigerator until ready to use.

5 Procedure

- 1) Remove the Calibration Kit from the refrigerator and allow the vials to warm to room temperature (1 to 2 hours).
- 2) Locate the Certified TOC Values (C of A Values) found on the accompanying *Certificate of analysis*. Record these TOC Values as required in the "SOP 700-1 Worksheet - Calibration" at the end of this *Standard Operating Procedure*.
- 3) Press the "menu" << icon on the upper right of the screen and press the bottle icon (3rd icon from the top).



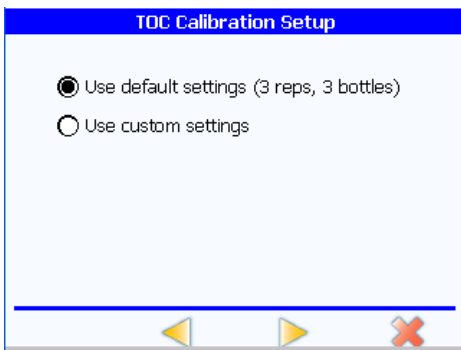
- 4) Press the "Run Standards" box.



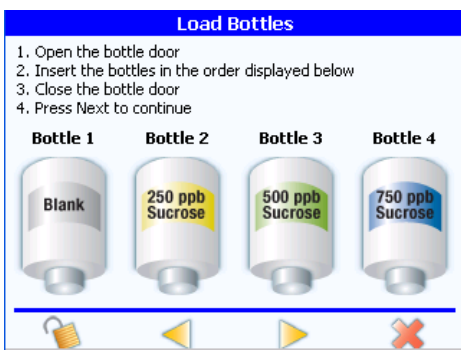
- 5) Press the "TOC Calibration" box.



- 6) Select the "Use default settings (3 reps, 3 bottles)" radio button. If you are going to run any other configuration select the "Use custom settings" radio button. This procedure will assume you are using the recommended default settings.



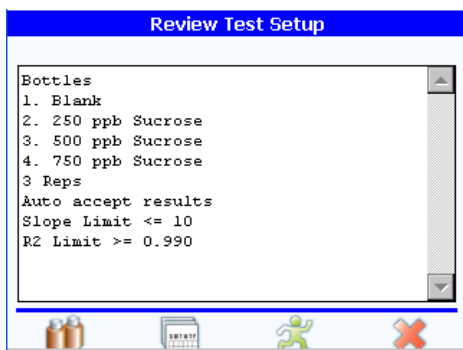
- 7) Press the "next" > icon.
 8) Follow the instructions from the screen ensuring that you place the standard bottles in the correct position as noted below:



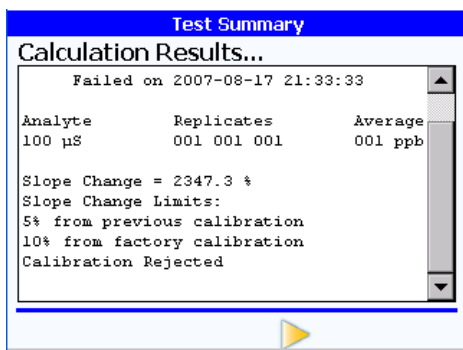
- From left to right
- Bottle 1 = Blank
- Bottle 2 = 250 ppb sucrose
- Bottle 3 = 500 ppb sucrose
- Bottle 4 = 750 ppb sucrose

- 9) Close the bottle door
- 10) Press the "next" > icon to continue
- 11) A "Review Test Setup" screen will appear. Verify the screen is correct with the following information:
 - 1. Blank
 - 2. 250 ppb Sucrose
 - 3. 500 ppb Sucrose
 - 4. 750 ppb Sucrose
 - 3 reps

Results acceptance, slope limit and R2 limit will be based on bottle mode settings. Manually accept results and stay offline is the default setting, with a slope limit of 15% and R² limit of 0.990.



- 12) Press the green "Run" button.
- 13) The system will start the calibration and continue until all bottles have been processed.
- 14) Upon completion of the calibration, a "Test Summary" screen will appear with the results of the calibration and the correlation coefficient. This will also appear on the printout if a printer is attached.
- 15) If the results of the test are within acceptable limits the results of the test can be accepted by selecting the "checkmark" icon. Pressing the cancel icon will avoid acceptance of the test results. If the test fails the results cannot be accepted and the test can be run again.
- 16) Follow the instructions for the "Unload/Replace Bottles", then press the "Done" icon.
- 17) Complete the Calibration Worksheet attached to the end of this document. Attach calibration worksheet.



6 Acceptance

Acceptance of the calibration is based on the change in slope (%sc) from the factory calibration and the correlation coefficient (R²) for the samples tested. If the slope change is ≤15% from the factory calibration the analyzer will automatically deem the calibration "acceptable" and allow user acceptance based on the correlation coefficient (R²). If the slope change is >15% the analyzer will deem the calibration "unacceptable" and you will be given the opportunity to repeat the calibration. The calibration automatically or manually accepted. If the unit is set for automatic acceptance the correlation coefficient defined in the TOC setup screen will be used. It is recommended that the calibration be accepted when the correlation coefficient is ≥0.990.

7 Further Action

If the Anatel PAT 700 TOC Analyzer is not within acceptable limits and the calibration was performed according to this Standard Operating Procedure, place the instrument in Self-Clean Mode for at least 30 minutes (refer to the Operator Manual - Anatel PAT 700 TOC Analyzer), then repeat the calibration procedure. If the analyzer fails the second calibration, contact Hach Ultra Analytics, Inc. with the following information:

- a) Instrument serial number
- b) Lot numbers for the standards
- c) Approximate volume left in each standard bottle
- d) Copy of results printout or electronic copy on USB
- e) Any other significant changes in operating conditions

SOP 700-1 Worksheet — Calibration

Instrument ID/Serial Number _____

Standards Information

Lot Number Certified TOC Value (C of A Value)

Reagent Water Blank: _____

250 ppb Sucrose Standard _____

500 ppb Sucrose Standard _____

750 ppb Sucrose Standard _____

Reagent Blank Measurements

_____ ppb C _____ ppb C

_____ ppb C

Average blank measurement _____ ppb C

250 ppb C Sucrose Standard Measurements

_____ ppb C _____ ppb C

_____ ppb C

Average 250 ppb C standard measurement _____ ppb C

500 ppb C Sucrose Standard Measurements

_____ ppb C _____ ppb C

_____ ppb C

Average 500 ppb C standard measurement _____ ppb C

750 ppb C Sucrose Standard Measurements

_____ ppb C _____ ppb C

_____ ppb C

Average 750 ppb C standard measurement _____ ppb C

Calibration Coefficient (R²) _____

TOC Calibration (circle one)

Pass / Fail

Comments

Initials: _____

Date: _____

Checked by _____

Date: _____

STANDARD OPERATING PROCEDURE

SOP Number: 700-2

Revision: Initial 1.0 Release

Validation of the Anatel PAT700 TOC Analyzer

Objective

Analyzing user-selected concentrations of sucrose validation standards after a TOC calibration has been performed provides validation of the Anatel PAT700 Analyzer's TOC calibration. The instrument response for the validation standard must have a deviation of less than 15% of the calibrated response to be considered acceptable.

Distribution List:

- _____
- _____
- _____
- _____
- _____
- _____

Approved by:

Reviewed by:

Effective date:



EXCELLENCE IN PROCESS ANALYTICS

1 Frequency

Validation of the PAT700 TOC Analyzer should be performed routinely according to industry regulations or company protocol thereafter.

2 Scope

This procedure is specific for the TOC Validation of the Anatel TOC Analyzer, models PAT700 PAT700100, PAT700200, PAT700300, PAT700400 and PAT700500.

3 Reference Documents

- Operator Manual - PAT700 (P/N FG7005002).
- "<643> Total Organic Carbon," *United States Pharmacopeia National Formulary USP 31-NF 26*, November 2007

4 Materials, Apparatus, and Chemicals

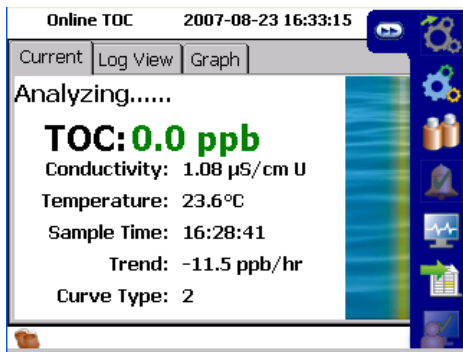
The standards kit used to perform the validation depends on the number of standards being used. The PAT700 TOC Validation Kit contains supplies for a single standard, while the PAT700 TOC Calibration Kit allows as many as three standards to be used.

- The PAT700 Validation Kit (P/N FG7019222) includes the following materials:
 - One (1) bottle of Reagent Water Blank
 - One (1) bottle of 500 ppb C Sucrose Standard
- The PAT700 Calibration Kit (P/N FG7019202) includes the following materials:
 - One (1) bottle of Reagent Water Blank
 - One (1) bottle of 250 ppb C Sucrose Standard
 - One (1) bottle of 500 ppb C Sucrose Standard
 - One (1) bottle of 750 ppb C Sucrose Standard

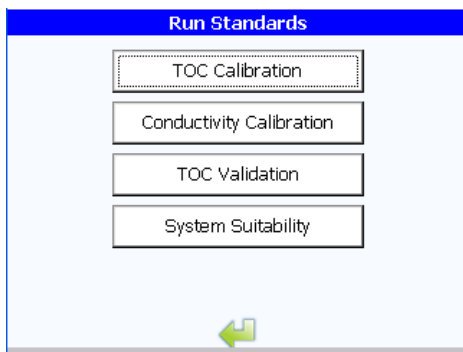
The Kit is valid for 30 days from the date of shipment and should be stored in a refrigerator until ready to use.

5 Procedure

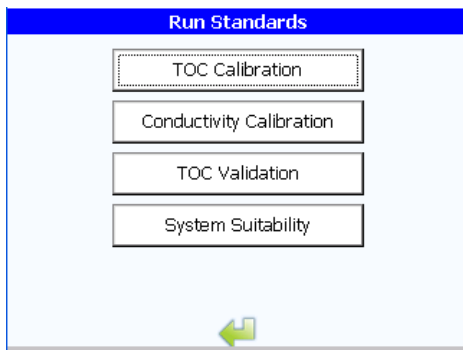
- 1) Remove the Validation Kit from the refrigerator and allow the vials to warm to room temperature (1 to 2 hours).
- 2) Locate the Certified TOC Values (C of A Values) found on the accompanying *Certificate of analysis*. Record these TOC Values as required in the "SOP 700-2 Worksheet - Validation" at the end of this *Standard Operating Procedure*.



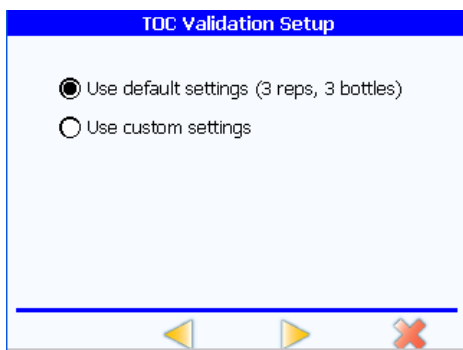
- 3) Touch the << icon on the upper right of the screen and select the "Bottle Mode" icon (3rd icon from the top).



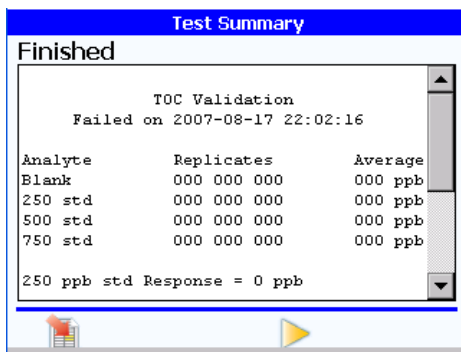
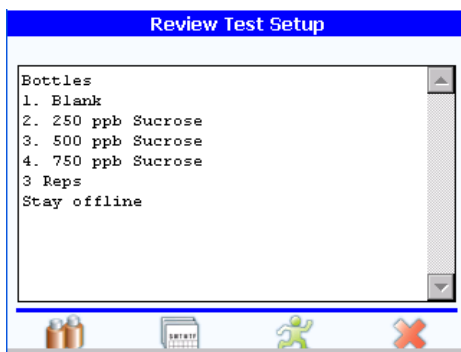
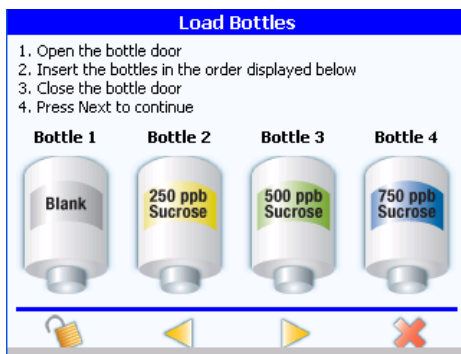
- 4) Touch the "Run Standards" box.



- 5) Touch the "TOC Validation" box.



- 6) 6. Select the "Use the default settings (3 reps, 1 bottles)" radio button when one 500 ppb standard is being used and custom settings when multiple standard concentrations are used.
- 7) Touch the "next" > icon.



- 8) Follow the instructions from the screen ensuring that you place the standard bottles in the correct position as noted below: (Note: The default setting is one bottle of 500ppb Sucrose.)

From left to right:

- Bottle 1 = Blank
 - Bottle 2 = 250 ppb sucrose
 - Bottle 3 = 500 ppb sucrose
 - Bottle 4 = 750 ppb sucrose
- 9) Close the bottle door.
- 10) Touch the "next" > icon to continue.
- 11) A "Review Test Setup" screen will appear. Verify the screen is correct with the following information:
- 1. Blank
 - 2. 250 ppb Sucrose
 - 3. 500 ppb Sucrose
 - 4. 750 ppb Sucrose
 - 3 reps
 - Stay offline (or return to a different user mode)
- 12) Touch the "Run" button
- 13) The system will start the validation and continue until all bottles have been processed.
- 14) Upon completion of the calibration, a "Test Summary" screen will appear with the results of the validation. This will also appear on the printout if a printer is attached.
- 15) Follow the instructions for the "Unload/Replace Bottles", then touch the "Done" icon.
- 16) Complete the Validation Worksheet at the end of this document.

6 Calculations

The percentage of deviation (%D) is calculated by dividing the validation response (r_V) minus the reagent water blank response (r_W), by the certified TOC value (r_C) from the *Certificate of Analysis* for the validation standard.

$$\%D = \left[\frac{(r_V - r_W)}{r_C} - 1 \right] \times 100$$

Where:

- r_V = Average TOC response for three measurements of the sucrose validation standard.
- r_W = Average TOC response for three measurements of background water used in the preparation of the validation standard.
- r_C = Certified TOC value from the *Certificate of Analysis* for the validation standard.

7 Acceptance

The instrument response for the Carbon Sucrose Validation Standard must have a deviation of less than $\pm 15\%$ from the *Certificate of Analysis* Validation standard value to be considered acceptable.

8 Further Action

If the Anatel PAT 700 TOC Analyzer is not within acceptable limits and the conductivity calibration was performed according to this Standard Operating Procedure, place the instrument in Self-Clean Mode for at least 30 minutes (refer to the *Operator Manual - Anatel PAT 700 TOC Analyzer*), then repeat the calibration procedure. If the analyzer fails the second calibration, contact Hach Ultra Analytics, Inc. with the following information:

- a) Instrument serial number
- b) Resistivity and temperature
- c) Lot numbers for the standards
- d) Approximate volume left in each standard bottle
- e) Copy of results printout or electronic copy on USB
- f) Any other significant changes in operating conditions

SOP 700-2 Worksheet — Validation (500 ppb Sucrose)

Instrument ID/Serial Number _____

Lot Number _____ C of A Value _____

Reagent Water Blank _____

500 ppb Sucrose Standard _____

Reagent Water Blank Measurements

_____ ppb C _____ ppb C _____ ppb C

Average Water Blank Measurement (r_w): _____ ppb C

500 ppb Sucrose Standard Measurements

_____ ppb C _____ ppb C _____ ppb C

Average 500 ppb Sucrose Standard Measurement (r_v): _____ ppb C

Show Validation Response Calculation:

$$r_v \quad \underline{\hspace{2cm}} \quad - \quad r_w \quad \underline{\hspace{2cm}} \quad = \quad \underline{\hspace{2cm}} \quad \text{ppb C}$$

Show Percent Deviation (%D) Calculation:

$$\left[\frac{(r_v - r_w)}{(r_c)} - 1 \right] \times 100 = \underline{\hspace{2cm}} \quad \%D$$

Comments:

Initials: _____

Date: _____

Checked by _____

Date: _____

SOP 700-2 Worksheet — Validation (250, 500, and 750 ppb Sucrose)

Instrument ID/Serial Number

	Lot Number	C of A Value
250 ppb Sucrose Standard	_____	_____
500 ppb Sucrose Standard	_____	_____
750 ppb Sucrose Standard	_____	_____

Reagent Water Blank Measurements

_____ ppb C _____ ppb C _____ ppb C
Average Water Blank Measurement (r_w): _____ ppb C

250 ppb Sucrose Standard Measurements

_____ ppb C _____ ppb C _____ ppb C
Average 250 ppb C Sucrose Standard Measurement (r_v): _____ ppb C

500 ppb Sucrose Standard Measurements

_____ ppb C _____ ppb C _____ ppb C
Average 500 ppb C Standard Standard Measurement (r_v): _____ ppb C

750 ppb Sucrose Standard Measurements

_____ ppb C _____ ppb C _____ ppb C
Average 750 ppb C Standard Standard Measurement (r_v): _____ ppb C

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Show 250 ppb C Validation Response Calculation:

$$r_V \underline{\hspace{2cm}} - r_W \underline{\hspace{2cm}} = \underline{\hspace{2cm}} \text{ ppb C}$$

Show Percent Deviation (%D) Calculation:

$$\left[\frac{(r_V - r_W)}{(r_C)} - 1 \right] \times 100\% = \underline{\hspace{2cm}} \%D$$

Show 500 ppb C Validation Response Calculation:

$$r_V \underline{\hspace{2cm}} - r_W \underline{\hspace{2cm}} = \underline{\hspace{2cm}} \text{ ppb C}$$

Show Percent Deviation (%D) Calculation:

$$\left[\frac{(r_V - r_W)}{(r_C)} - 1 \right] \times 100\% = \underline{\hspace{2cm}} \%D$$

Show 750 ppb C Validation Response Calculation:

$$r_V \underline{\hspace{2cm}} - r_W \underline{\hspace{2cm}} = \underline{\hspace{2cm}} \text{ ppb C}$$

Show Percent Deviation (%D) Calculation:

$$\left[\frac{(r_V - r_W)}{(r_C)} - 1 \right] \times 100\% = \underline{\hspace{2cm}} \%D$$

Comments:

Initials: _____

Date: _____

Checked by _____

Date: _____

STANDARD OPERATING PROCEDURE

SOP Number: 700-3

Replaces Revision: Initial 1.0
Release

System Suitability of the Anatel PAT700 TOC Analyzer

Objective

System suitability provides a field confirmation of the performance and oxidation efficiency of Anatel online Total Organic Carbon instrumentation. TOC values are determined by measuring the change in conductivity of a high-purity water sample as its organic compounds are oxidized to carbon dioxide inside the instrument's analysis cell. The confirmation procedure compares the average of a series of TOC measurements from an easy to oxidize working standard (in the form of sucrose) to the average of a corresponding series of measurements of a hard to oxidize system suitability solution (in the form of 1,4-Benzoquinone). The system is deemed suitable if the response efficiency is not less than 85% and not more than 115%.

Note: This Standard Operating Procedure does not attempt to address safety issues associated with its performance. It is the user's responsibility to establish appropriate safety and health practices, as well as determine the applicability of any pertinent regularity restrictions prior to use.

Distribution List:

- _____
- _____
- _____
- _____
- _____
- _____

Approved by:

Reviewed by:

Effective date:



EXCELLENCE IN PROCESS ANALYTICS

1 Frequency

System Suitability of the PAT 700 TOC Analyzer should be performed routinely according to industry regulations or company protocol thereafter.

2 Scope

This procedure is specific for the TOC System Suitability of the Anatel TOC Analyzer, models PAT700 PAT700100, PAT700200, PAT700300, PAT700400 and PAT700500.

3 Reference Documents

- Operator Manual - PAT700 (P/N 7005002)
- "<643> Total Organic Carbon," *United States Pharmacopeia National Formulary USP 31-NF 26*, November 2007
- ISO method 8245 "Guidelines for the Determination of Total Organic Carbon."

4 Materials, Apparatus, and Chemicals

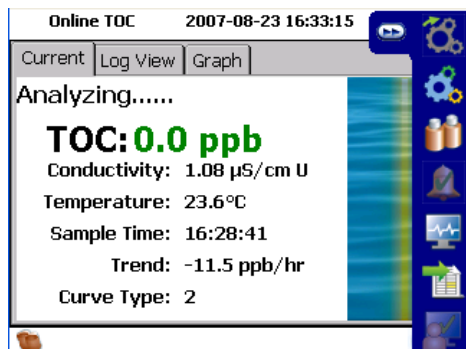
Anatel PAT700 System Suitability Kit (P/N FG 7018402), including the following:

- One (1) Vial of Reagent Water Blank
- One (1) Vial of 500 ppb C Sucrose Standard
- One (1) Vial of 500 ppb C 1,4-Benzoquinone Standard

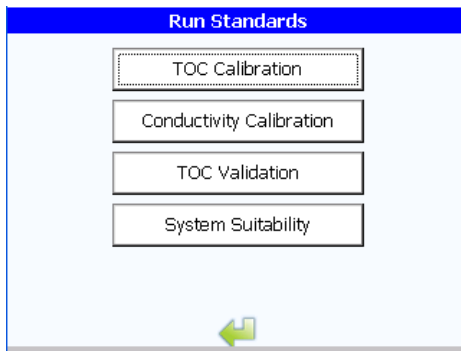
The Kit is valid for 30 days from the date of shipment and should be stored in a refrigerator until ready to use.

5 Procedure

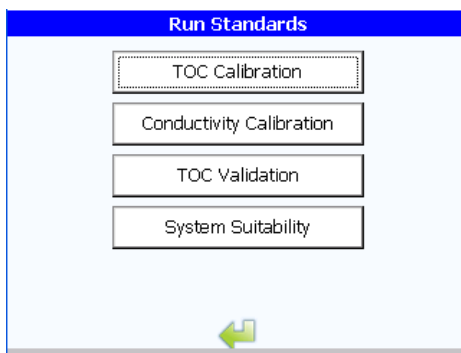
- 1) Remove the System Suitability Kit from the refrigerator and allow the vials to warm to room temperature (1 to 2 hours).
- 2) Locate the Certified TOC Values (C of A Values) found on the accompanying *Certificate of analysis*. Record these TOC Values as required in the "SOP 700-3 Worksheet - System Suitability" at the end of this Standard Operating Procedure.
- 3) Press the << icon on the upper right of the screen and select the "Bottle Mode" icon (3rd icon from the top).



- 4) Touch the "Run Standards" box.



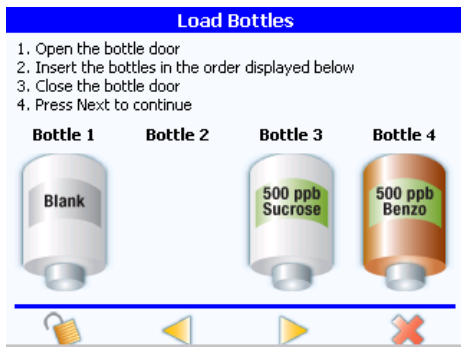
- 5) 5.Press the "System Suitability" box.



- 6) Follow the instructions from the screen ensuring that you place the standard bottles in the correct position as noted below:

From left to right:

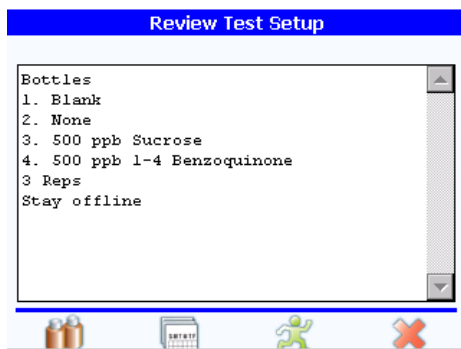
- Bottle 1 = Blank
- Bottle 2 = empty
- Bottle 3 = 500 ppb sucrose
- Bottle 4 = 500 ppb benzo



- 7) Close the bottle door.
8) Press the "next" > icon to continue.

- 9) A "Review Test Setup" screen will appear. Verify the screen is correct with the following information:

- 1. Blank
- 2. None
- 3. 500 ppb Sucrose
- 4. 500 ppb Benzo
- 3 reps
- Stay offline (or return to previously selected mode)



- 10) Press the green "Run" button
11) The system will start the test and continue until all bottles have been processed.

Test Summary		
Finished		
System Suitability Test Failed on 2007-08-17 23:12:16		
Analyte	Replicates	Average
rW	000 000 000	000 ppb
500 rS	000 000 000	000 ppb
500 rSS	000 000 000	000 ppb
Limit response (rS-rW): 000 ppb		
Suitability response (rSS-rW): 000 ppb		

- 12) Upon completion of the test, a "Test Summary" screen will appear with the results of the test and whether the test passed or failed. This will also appear on the printout if a printer is attached.
- 13) Press the "next" icon to proceed.
- 14) Follow the instructions for the "Unload/Replace Bottles", then press the "Done" icon.
- 15) If the test failed, press on the "trash can" icon and select the "checkmark" icon if you want to run again or the trash can if you want to cancel the run.
- 16) Complete the System Suitability Worksheet attached to this document.

6 Acceptance

The analyzer is deemed suitable for use in measuring TOC levels of high-purity water if the response efficiency (RE) (the ratio of rSS/rs expressed as a %) is not less than 85% and not more than 115%.

7 Further Action

If the Anatel PAT 700 TOC Analyzer is not within acceptable limits and the System suitability was performed according to this Standard Operating Procedure, place the instrument in Self-Clean Mode for at least 30 minutes (refer to the *Operator Manual - Anatel PAT 700 TOC Analyzer*), then repeat the calibration procedure. If the analyzer fails the second calibration, contact Hach Ultra Analytics, Inc. with the following information:

- a) Instrument serial number
- b) Lot numbers for the standards
- c) Approximate volume left in each standard bottle
- d) Copy of results printout or electronic copy on USB
- e) Sample resistivity and temperature
- f) Any other significant changes in operating conditions

SOP 700-3 Worksheet — System Suitability

Instrument ID/Serial Number _____

Lot Number _____

C of A Value _____

Reagent Water Blank: _____

500 ppb C Sucrose Standard: _____

500 ppb C 1,4-Benzoquinone Standard: _____

Reagent Water Blank Measurements

_____ ppb C

_____ ppb C

_____ ppb C

Average reagent water measurement (r_w) in ppb C: _____

500 ppb C Sucrose Standard Measurements

_____ ppb C

_____ ppb C

_____ ppb C

Average sucrose standard measurement (r_s) in ppb C: _____

500 ppb C 1,4-Benzoquinone Standard Measurements

_____ ppb C

_____ ppb C

_____ ppb C

Average 1,4-benzoquinone standard measurement (r_{ss}) in ppb C: _____

Response Calculations

System Response Calculation

$$r_{ss} \quad \underline{\hspace{2cm}} \quad - \quad r_w \quad \underline{\hspace{2cm}} \quad = \quad \underline{\hspace{2cm}} \quad \text{ppb C}$$

Limit Response Calculation

$$r_s \quad \underline{\hspace{2cm}} \quad - \quad r_w \quad \underline{\hspace{2cm}} \quad = \quad \underline{\hspace{2cm}} \quad \text{ppb C}$$

Response Efficiency Calculation

$$\frac{(r_{ss} - r_w)}{(r_s - r_w)} \times 100 = \underline{\hspace{2cm}} \quad R_E$$

Comments

Initials: _____

Date: _____

Checked by _____

Date: _____

STANDARD OPERATING PROCEDURE

SOP Number: 700-4

Replaces Revision: Initial 1.0
Release

Conductivity Calibration of the Anatel PAT700 TOC Analyzer

Objective

Conductivity calibration provides a field confirmation of the performance and oxidation efficiency of Anatel online Total Organic Carbon instrumentation. The values are determined by measuring the conductivity of a high-purity water sample prior to oxidation of organic compounds into carbon dioxide inside the instrument's analysis cell. The calibration consists of verifying the cell constant by measuring a solution of known conductivity. The cell constant is adjusted to the value of the conductivity standard, and therefore, is always within $\pm 2\%$.

Distribution List:

- _____
- _____
- _____
- _____
- _____
- _____

Approved by:

Reviewed by:

Effective date:

Note: To ensure a proper operation the Anatel PAT700 has an internal limit on the allowable deviation of the calibration. If the new calibration is greater than $\pm 10\%$ of the factory calibration or $\pm 5\%$ of the previous User calibration, the calibration is unacceptable and a new calibration is required.

Note: This Standard Operating Procedure does not attempt to address safety issues associated with its performance. It is the user's responsibility to establish appropriate safety and health practices, as well as determine the applicability of any pertinent regulatory restrictions prior to use.



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1 Frequency

Conductivity calibration of the PAT 700 TOC Analyzer should be performed routinely according to industry regulations or company protocol thereafter.

2 Scope

This procedure is specific for the TOC Conductivity Calibration of the Anatel TOC Analyzer, models PAT700 PAT700100, PAT700200, PAT700300, PAT700400 and PAT700500.

3 Reference Documents

- Operator Manual - PAT700 (P/N 7005002)
- "<643> Total Organic Carbon," *United States Pharmacopeia National Formulary USP 31-NF 26*, November 2007
- ISO method 8245 "Guidelines for the Determination of Total Organic Carbon."
- ASTM method D1125, "Standard Test Methods for Electrical Conductivity and Resistivity of Water."

4 Materials, Apparatus, and Chemicals

Anatel PAT700 Conductivity Kit (P/N FG7002602), including the following:

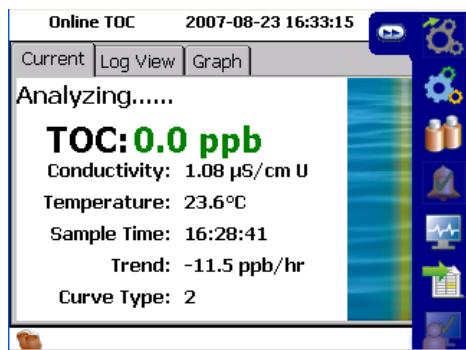
- One (1) Vial of 100 microsiemen Conductivity standard
- One certified calibration resistor (optional) (P/N FG7001009)

The Kit is valid for 60 days from the date of shipment and should be stored in a refrigerator until ready to use.

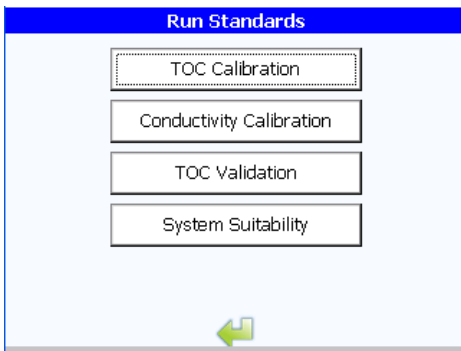
5 Procedure

Note: Conductivity Calibration can be performed with or without a resistor check. If you elect to use a resistor. Enter the "Setup" menu, then press the "Bottles" icon. Press the "Conductivity" tab and check "Use the Calibration Resistor" box.

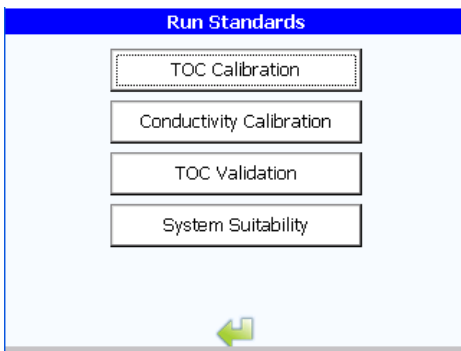
- 1) Remove the Conductivity Kit from the refrigerator and allow the vial to warm to room temperature (1 to 2 hours).
- 2) Locate the Certified TOC Values (C of A Values) found on the accompanying *Certificate of analysis*. Record these TOC Values as required in the "SOP 700-3 Worksheet - System Suitability" at the end of this *Standard Operating Procedure*.
- 3) Press the << icon on the upper right of the screen and select the "Bottle Mode" icon (3rd icon from the top).



4) Touch the "Run Standards" box.

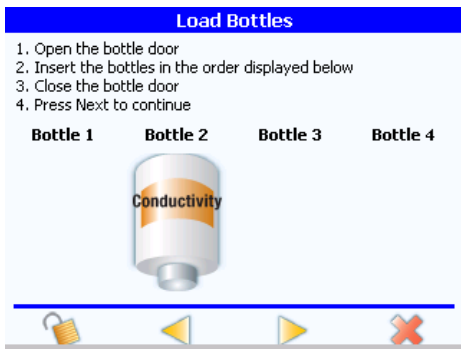


5) Press the "Conductivity Calibration" box.



6) Insert the bottle into the number 2 position as instructed.

7) Press the "next" > icon.

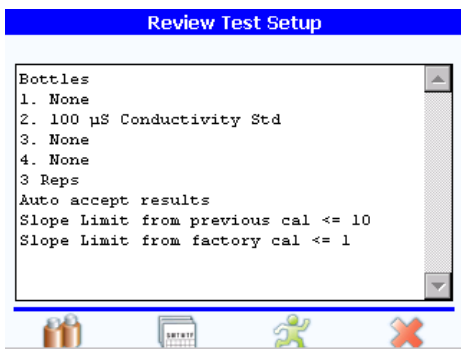


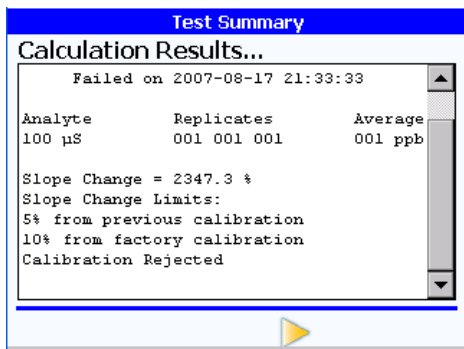
8) The "Review Test Setup" screen appears.

9) Verify the information is correct and then press the "Run" icon.

10) If a resistor is used the system will ask you to insert the calibration resistor by plugging into the serial printer port. Immediately following the resistor verification the analyzer will immediately begin sampling the conductivity standard solution.

11) The system will start the calibration and continue until the bottle has been processed.





- 12) A "Test Summary" screen will appear after calibration providing the results. If the test passed, click on the check mark and follow the procedure for "Unload/Replace Bottles"
- 13) Follow the instructions for the "Unload/Replace Bottles", then press the "Done" icon.
- 14) If the test failed, press on the "trash can" icon and select the "checkmark" icon if you want to run again or the "trash can" icon if you want to cancel the run.

6 Calculations

The difference (MR_{Diff}) between the certified calibration resistor value and the Anatel PAT700 measured value is calculated by subtracting the actual measured resistor value (MR_{Actual}) from the resistor value of the precision calibration resistor (R_{Ref}) and multiplying it by the current cell constant.

$$MR_{Diff} = (R_{Ref} - MR_{Actual}) \times \text{Cell Constant}$$

Where:

MR_{Diff} = The difference between the PAT700's measured resistor value in $\mu\text{S}/\text{cm}$ and the product of the actual Certified Calibration Resistor value times the Cell Constant:

$$MR_{Diff} = MR_{Theory} - MR_{Actual}$$

MR_{Theory} = The value that the PAT700 should report during meter calibration:

$$MR_{Theory} = C_{Ref} \times \text{Cell Constant}$$

C_{Ref} = The actual value of the Certified Calibration Resistor in μS , represented by the equation:

$$C_{Ref} = \frac{1}{(R_{Ref})K\Omega} \times 1000$$

R_{Ref} = The actual value of the Certified Calibration Resistor in $M\Omega$ as listed in the Certificate of Calibration.

MR_{Actual} = The PAT700 Analyzer's measured resistor value.

Cell Constant = The Cell Slope that is set during factory calibration.

The new User Conductivity Slope (S_N) is calculated by dividing the labeled conductivity of the standard (C_L) by the averaged measured conductivity value of the standard solution (C_M).

$$S_N = \frac{C_L}{C_M}$$

Where:

S_N = The User Conductivity Slope determined during the current Conductivity Calibration

S_C = The change in User Conductivity Slope determined by dividing the new slope by the last slope and represented by the equation:

$$S_C = \left[\frac{S_N}{S_O} - 1 \right] \times 100\%$$

S_O = The User Conductivity Slope that was determined during the last successful conductivity calibration

C_L = The labelled conductivity of the Standard

C_M = The analyzer's average measured conductivity value

C_K = The percent difference between the actual conductivity standard value and the PAT700's measured conductivity value in $\mu\text{S/cm}$.

7 Acceptance

If the calculated slope change is not more than 5% from the previous calibration or 10% from the factory calibration the analyzer will allow the acceptance of the conductivity calibration. Accepting the calibration automatically causes the cell constant is adjusted to the value of the conductivity standard, and therefore the analyzer measurement is within $\pm 2\%$ of the standard.

If the calculated slope change is more than 5% from the previous calibration or 10% from the factory calibration the analyzer will not allow the acceptance of the calibration, and a new calibration must be performed.

8 Further Action

If the Anatel PAT 700 TOC Analyzer is not within acceptable limits and the conductivity calibration was performed according to this Standard Operating Procedure, place the instrument in Self-Clean Mode for at least 30 minutes (refer to the *Operator Manual - Anatel PAT 700 TOC Analyzer*), then repeat the calibration procedure. If the analyzer fails the second calibration, contact Hach Ultra Analytics, Inc. with the following information:

- a) Instrument serial number
- b) Sample resistivity and temperature
- c) Any other significant changes in operating conditions

SOP 700-4 Worksheet — Conductivity Calibration

Instrument ID/Serial Number _____

Current User Conductivity Slope (S_O) (Determined during last successful conductivity calibration): _____

Cell Constant (Cell Slope): _____

Meter Calibration

Certified Calibration Resistor Serial Number: _____

Date of last Certification: _____

Actual Value of the Certified Calibration Resistor (R_{Ref}) from the Certificate of Accuracy: _____ KΩ

Actual Value of the Certified Calibration Resistor expressed in μS (C_{Ref}):
 $\frac{1}{(R_{Ref})K\Omega} \times 1000 =$ _____ C_{Ref}

Meter Result, Theory (MR_{Theory}): C_{Ref} x Cell Constant = _____ μS/cm

Meter Result, Actual (MR_{Actual}): _____ μS/cm

Show Differential Measurement (MR_{Diff}) Calculation:

MR_{Theory} _____ - MR_{Actual} _____ = _____ MR_{Diff}

Is MR_{Diff} ≥ -0.1 μS/cm and is MR_{Diff} ≤ 0.1 μS/cm? Yes (Pass) / No (Fail)

Conductivity Calibration

Measured Value of the Conductivity Standard:

_____ $\mu\text{S/cm}$ _____ $\mu\text{S/cm}$ _____ $\mu\text{S/cm}$

Average measured conductivity value (C_M): _____ $\mu\text{S/cm}$

Value of the Conductivity Standard from the *Certificate of Analysis* (C_L):

_____ $\mu\text{S/cm}$

Show User Conductivity Slope Calculation:

$$\frac{C_L}{C_M} = \frac{S_N}{S_M}$$

Conductivity Calibration Status:

Accepted / Not Accepted

Comments:

Initials: _____

Date: _____

Checked by _____

Date: _____

Acknowledgements and Disclosures

Disclosures

The information in this SOP has been carefully checked and is believed to be accurate. However, Hach Ultra Analytics, Inc. assumes no responsibility for any inaccuracies that may be contained in this document. In no event will Hach Ultra Analytics, Inc. be liable for direct, indirect, special, incidental, or consequential damages resulting from any defect or omission in this manual, even if advised of the possibility of such damages. In the interest of continued product development, Hach Ultra Analytics, Inc. reserves the right to make improvements in this manual and the products it describes at any time, without notice or obligation.

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Acknowledgements

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Notes