THORNTON
Leading Pure Water Analytics

Part No. 58130095

5000TOCe Sensor Standard Operating Procedure

for TOC Calibration

METTLER TOLEDO

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IMPORTANT SAFETY INFORMATION

Please read thoroughly before operating the 5000TOCe System Suitability Test Kit and the 5000TOCe Calibration Kit

- Follow all warnings, cautions, and instructions indicated on and supplied with this product.
- Install equipment as specified in this instruction manual. Follow appropriate local and national codes.
- Use only factory documented components for repair. Tampering or unauthorized substitution of parts and procedures can affect the performance and cause unsafe operation of your process as well as void factory warranties.
- Protective covers must be in place unless qualified personnel are performing maintenance.
- If this equipment is used in a manner not specified by the manufacturer, the protection provided by it against hazards may be impaired.
- Prior to shipping the sensor back to the factory for repair or re-calibration, water MUST be drained from sensor to avoid damage due to freezing.

WARNINGS:

- Installation of cable connections and servicing of this product require access to shock hazard voltage levels.
- Main power must employ a switch or circuit breaker as the disconnecting device for the equipment.
- Electrical installation must be in accordance with the National Electrical Code and/or any other applicable national or local codes.
- Safety and performance require that this instrument be connected and properly grounded through a three-wire power source.

This manual includes safety information with the following designations and formats:

WARNING: POTENTIAL FOR PERSONAL INJURY.

CAUTION: possible instrument damage or malfunction.

NOTE: important operating information.

Definition of Equipment Symbols

On the instrument indicates: Warning, risk of electric shock.

On the instrument indicates: Caution (refer to accompanying documents).

On the instrument indicates: There is alternating current present.

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1. Introduction

The Thornton 5000TOCe Total Organic Carbon Sensor and 770MAX meter measures the amount of organic carbon in high purity waters by oxidizing organic carbon to CO_2 with appropriate UV radiation. The resulting increase between two temperature-compensated conductivity measurements of the sample flow stream at points before and after oxidation is used to calculate the amount of total organic carbon present.

2. Scope

This document provides procedures to calibrate the Thornton 5000TOCe or 5000TOC Total Organic Carbon Sensor (PN 58 036 001, PN 58 036 002, 58 036 003, 58 036 004). The 5000TOCe Sensor is used with the Thornton 770MAX transmitter. Calibration of the 770MAX transmitter is covered in separate documentation. Throughout this manual, references will be made to the 5000TOCe sensor model. In all cases, this can be interpreted to include the 5000TOCe and 5000TOC sensor models.

3. Equipment Required

- Thornton 5000TOCe CAL/SST Module Kit (Thornton PN 58 091 559)
- Thornton 5000TOCe Calibration Solution Set (Thornton PN 58 091 529) or Thornton 5000TOCe Combination Solution Set (Thornton P/N 58 091 537)

4. UUT Equipment Information

Record all relevant information regarding the unit under test (UUT) in Worksheet 1: Unit Under Test Information.

5. Calibration Equipment Preparation

Note: Use a hold time to freeze the relay and analog outputs so that alarms are not triggered during any service procedures. Normal relay and analog output operation resumes when the set period has elapsed or when the hold time is reset to zero. Set hold time by pressing "Menu" from the 770MAX main display. Scroll to "Set Hold time" by using the up/down arrows. Press "Enter", then enter a time between 1 to 99 minutes, and press "Menu". The hold time is now set.

Caution: Be sure to adjust needle valve to less than 3 turns from closed position before re-installing into process line!

5.1. Install CAL/SST Module (part no. 58 091 559)

This section discuses the installation process for CAL/SST Module kit P/N 58 091 559. For use of 58 091 525, refer to Appendix 1 at the end of this document.

CAL/SST Module Kit 58 091 559 provides the apparatus needed to perform a system suitability test on the 5000TOCe Sensor (PN's 58 036 001, 58 036 002, 58 036 003 and 58 036 004). Components contained in this kit include the pump module, a mounting bracket, connecting tubing equipped with quick-disconnect fittings, a universal power supply and assorted tools. This kit is designed for use with Thornton Standard Solution bottles included in the calibration Solutions Kit (p/n 58 091 529 and 58 091 537).

5.2. TOC Calibration and SST Kit Installation and Setup

1. Remove the mounting bracket from the carrying case and place on top of the 5000TOCe Sensor to be tested. See Figure 1.
2. Connect the CAL/SST Module to the mounting bracket. Ensure that the bracket and module are aligned to the left side of the sensor so that UV Lamp power button is accessible and the indicating LED's are visible.
3. Remove the 60 micron filter assembly from the 5000TOCe Sensor inlet.
4. Attach the threaded end of connection tube equipped with the male quick-disconnect fitting to the 5000TOCe Sample Inlet connection. After the threaded connection is made, push the quick-disconnect fitting into mating connector found on the top right side of the CAL/SST pump module. Ensure proper connection is made.

Set selector valve on CAL/SST pump module to “SST/TOC CAL” position. Figure 1 shows the proper installation of the CAL/SST pump module.

5. Verify the pump power switch is in the off position. The switch is located on the right side of the module.
6. Connect the Universal Power Supply to the pump and to 100–240 VAC 50-60 Hz power. The kit includes a universal AC adaptor with assorted international standard connectors. Select the appropriate AC connector, and install it onto the AC adaptor and connect to the AC supply.

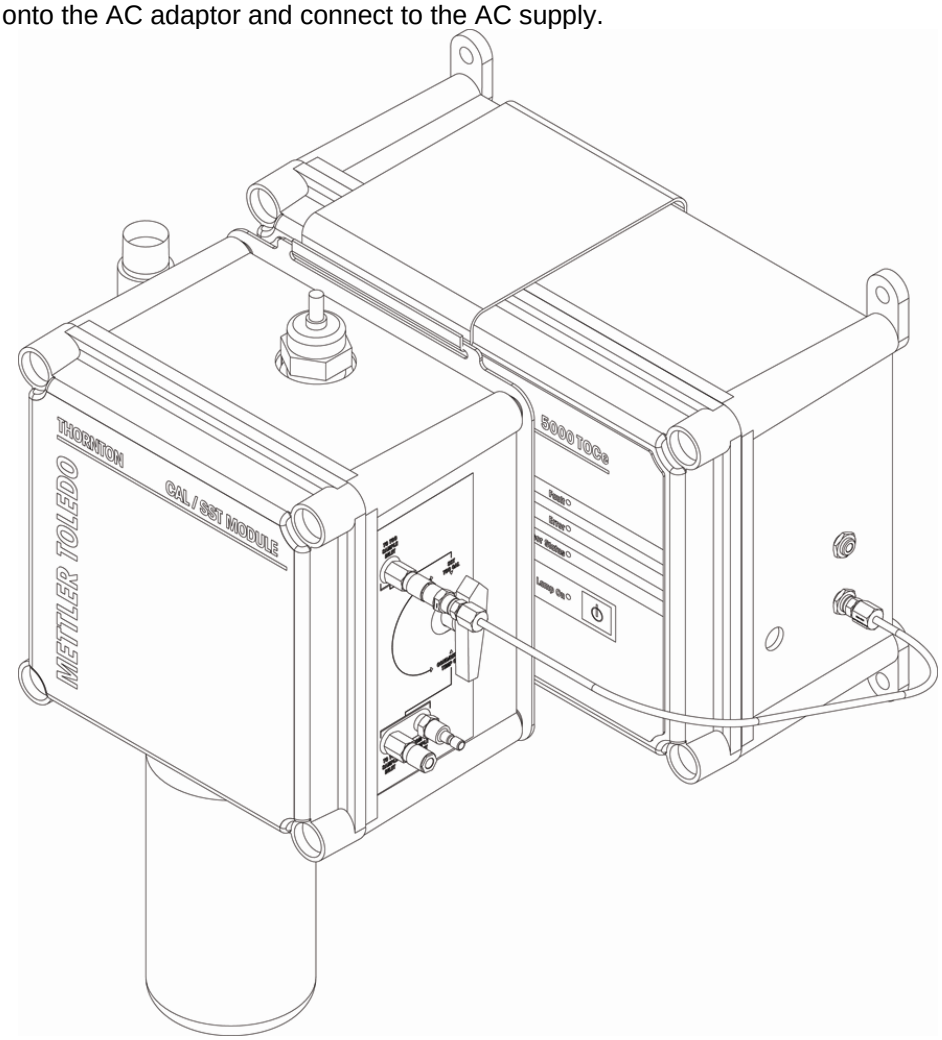

Figure 1. CAL/SST Pump Module Installation and Setup

When required by the procedure, a calibration standard solution bottle can be attached to the CAL/SST Pump Module as follows:

7. Remove the threaded grey, protective cap from the bottom of the CAL/SST Pump Module.
8. Wearing clean protective gloves to avoid contamination, insert a silicone suction tube onto the suction fitting located in the bottle receptacle as shown in Figure 2. A fresh suction tube should be used for each calibration. Protective gloves and a replacement suction tube are provided with each calibration solution kit.
9. Break the protective seal on a Blank Water bottle and remove cap. Set cap aside for re-use if any calibration solutions remain after completion of the test.

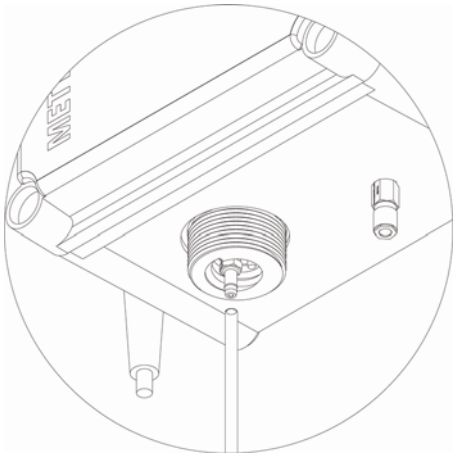

Figure 2. Suction Tube installation

10. Insert free end of the suction tube into the mouth of the bottle while raising the bottle into place. Screw the blank water bottle directly into the solution bottle receptacle at the base of the CAL/SST pump module.
11. Verify the original drain tube is connected to the Sample Outlet of the 5000TOCe Sensor and run to atmospheric drain. It is critical not to re-circulate this solution.
12. Turn the pump power switch to ON. Note water dripping from the sensor discharge tubing at the atmospheric drain. Allow the sensor to purge for at least 5-10 minutes.
13. Turn the pump OFF.

The CAL/SST module is now ready to perform the TOC Calibration.

6. TOC Calibration

Calibration is performed using a solution(s) of known TOC concentration(s). Mettler-Toledo Thornton provides the 5000TOCe Calibration Solution Set (P/N 58 091 529 and 58 091 537) with a bottle of 500 ppb TOC (sucrose) and 250 ppb TOC (sucrose) calibration solutions for this purpose.

6.1. TOC As Found (if required)

1. Record all data in Worksheet 2: As Found Data for TOC
2. Record the As Found TOC Multiplier(s) and Adder(s) found in the Measurement Menu on the 770MAX.
3. Record Lamp Lifetime (hrs).
4. Remove the Blank Water bottle from the calibration apparatus and replace it with 500 ppb TOC (sucrose) solution.
5. Verify the original drain tube is connected to the Sample Outlet of the 5000TOCe Sensor and run to atmospheric drain. Do NOT re-circulate this solution.
6. Turn on the pump. Water should now be visible at the drain line at the atmospheric drain. The ~500 mL volume of the calibration solution will provide more than 20 minutes of operation at the nominal flow rate of 20 mL/min.
7. Adjust the flow rate to 20 mL/min per Section 8.
8. Verify that UV Lamp is on. The lamp must be on to measure and display TOC.
9. Allow the 500 ppb TOC solution to flow through the 5000TOCe Sensor until the readings stabilize, approximately 5 minutes.
10. Record the TOC as written on the label of the 500 ppb TOC solution or its certificate, TOC_{ref} on Worksheet 2, provided later in this document.
11. Record the measured TOC displayed on the 770MAX, TOC_{before}. on Worksheet 2.
12. Compute the difference, TOC_{ref} - TOC_{before}.
13. If the absolute value of the difference for 500 ppb TOC solution is less than the limit, then a TOC calibration is not required.
14. If calibration is required, proceed to Section 6.2.

"As Found" is complete.

6.2. TOC Calibration Procedure

1. Record data in Worksheet 3: TOC Calibration and Verification.
2. Press Menu (exit) to go to MAIN MENU.
3. Press ▲ or ▼ to select Calibrate. Press Enter (or Page Down).
4. Press ▲ or ▼ to select Sensor. Press Enter (or Page Down).
5. Enter Output Hold Time. Press Enter (or Page Down).
6. Press ▲ or ▼ to select the letter for the measurement of the 5000TOCe Sensor displaying TOC. Press Enter.
7. Press ▲ or ▼ to select **Multi**. Press Enter or ▶ (use 1-point if 770MAX software revision is earlier than v5.2).
8. Press ▲ or ▼ to select TOC. Press Page Down.
9. Press ▲ or ▼ to set the flow rate to YES. (skip this step if 770MAX software revision is earlier than v5.2)

10. The LED lights will now indicate flow. Adjust the flow rate to 20 mL/min per Section 8, if necessary.(skip this step if 770MAX software revision is earlier than v5.2)
11. Press ▲ or ▼ to set the flow rate to NO. Press Page Down. (skip this step if 770MAX software revision is earlier than v5.2)
12. Allow the 500 ppb TOC solution readings to flow through the 5000TOCe Sensor until the readings stabilize, approximately 5 minutes.
13. Enter the TOC of the Reference Solution as written on the label or its certificate into the 770MAX for Cal pt 1.
14. Press Page Down.
15. Wait for calibration to complete. If 770MAX software revision is earlier than v5.2 then skip to step 28.
16. Turn off pump.
17. Remove the 500 ppb TOC solution bottle from the calibration apparatus and replace it with 250 ppb TOC solution.
18. Turn on the pump.
19. Verify that UV Lamp is on. The lamp must be on to measure and display TOC.
20. Press ▲ or ▼ to set the flow rate to YES.
21. The LED lights will now indicate flow.
22. Adjust the flow rate to 20 mL/min per Section 8.
23. Press ▲ or ▼ to set the flow rate to NO. Press Page Down.
24. Allow the 250 ppb TOC solution to flow through the 5000TOCe Sensor until the readings stabilize, approximately 5 minutes.
25. Enter the TOC of the Reference Solution as written on the label or its certificate into the 770MAX for Cal pt 2.
26. Press Page Down.
27. Wait for calibration to complete.
28. Enter the correct date. Press Page-Down.
29. Select YES to save the new calibration data within the 5000TOCe Sensor.

Note: if NO is selected, the calibration data will only be temporarily saved, and the calibration factors will revert back to the previous values should power be lost or the 5000TOCe Sensor patch cable is unplugged.

30. Return the 770MAX to measurement mode by pressing the Menu (exit) key twice. If 770MAX software revision is earlier than v5.2 then skip to step 41.
31. Record the TOC as written on the label of the 250 ppb solution or its certificate. This is TOC_{ref}.
32. Record the measured TOC displayed on the 770MAX, TOC_{after}.
33. Verify that difference is within acceptable limits.
34. Turn off pump.
35. Remove the 250 ppb TOC solution bottle from the calibration apparatus and replace it with 500 ppb TOC solution..
36. Turn on pump.
37. Verify that UV Lamp is on. The lamp must be on to measure and display TOC.
38. Adjust the flow rate to 20 mL/min per Section 8.
39. Allow the 500 ppb solution to flow through the 5000TOCe Sensor until the readings stabilize, approximately 5-10 minutes.
40. Return the 770MAX to measurement mode by pressing the Menu (exit) key twice.
41. Record the TOC as written on the label of the 500 ppb solution or its certificate. This is TOC_{ref}.
42. Record the measured TOC displayed on the 770MAX, TOC_{after}.
43. Verify that difference is within acceptable limits in this worksheet.
44. Enter the Lamp Life.
45. Press Menu (exit) key to go to MAIN MENU.
46. Press ▲ or ▼ to select Measurement. Press Enter (or Page Down).

47. Press ▲ or ▼ to select the letter for the measurement of the 5000TOCe Sensor displaying TOC.
48. Press Page Down.
49. Record the value of new TOC Multiplier(s) and adder(s) from the 770MAX display.
50. If the difference is not within acceptable limits, repeat Section 6.2. TOC Calibration Procedure.

TOC Calibration is complete.

7. Restore to Operation

Caution: Be sure to adjust needle valve to less than 3 turns from closed position before re-installing into process line!

1. Restore the connections to the unit in the same operational configuration prior to calibration.
2. Remove the TOC Calibration Kit or System Suitability Kit.
3. Connect the process water line to the 5000TOCe Sensor sample inlet.
4. Turn on the process water supply to the 5000TOCe Sensor using the shut off valve (recommended in the 5000TOCe Sensor Instruction Manual). Insure the process water supply is turned on by viewing the discharge line at the atmospheric drain.
5. Adjust the flow rate to 20 mL/min per Section 8.
6. Turn on the UV Lamp.

Worksheet 1: Unit Under Test Information

Use the table below to record relevant information for the unit under test.

770MAX and 5000TOCe Sensor Unit Under Test (UUT) Data			
770MAX UUT		**5000TOCe Sensor UUT**	
Part Number		**Part Number**	
Serial Number		**Serial Number**	
ID Tag (if available)		**ID Tag (if available)**	
Date Last Calibrated		**Date Last Calibrated**	
Date Calibration Due		**Date Calibration Due**	

Reference TOC Solution Manufacturing Dates/Lot #/Notes	
500 ppb TOC Solution	
250 ppb TOC Solution	

Name (printed)	
Signature	
Date	
Comments	

Worksheet 2: As Found Data for TOC

☐ Check if not applicable

Nominal	Reference TOC_{ref} (ppb)	As Found TOC_{before} (ppb)	TOC_{ref} - TOC_{before} (ppb)	Limit (ppb)	Adjustment Required (Y/N)
TOC, 500 ppb				±50	
TOC Calibration Factors		**Multiplier1** **Multiplier2***		**Adder1** **Adder2***	
Lamp Life (hrs)					
Name (printed)					
Signature					
Date					
Comments					

*Note: If software revision v5.2 or higher is being used with "multi" calibration type, a second multiplier/adder will appear.

Worksheet 3: TOC Calibration and Verification

☐ Check if not applicable

	Reference TOC_{ref} (ppb)	TOC_{after} (ppb)	$TOC_{ref} - TOC_{after}$ (ppb)	Limit (ppb)	Within Limits? (Y or N)
TOC, 500 ppb				±50	
TOC, 250 ppb*				±25	

TOC Calibration Factors	**Multiplier1**		**Adder1**	
	Multiplier2*		**Adder2***	

Lamp Life (hrs)	

Name (printed)	
Signature	
Date	
Comments	

*Note: If software revision v5.2 or higher is being used with "multi" calibration type, a second multiplier/adder will appear.

8. Appendix - Setting Sample Flow Rate

At various times during the calibration of TOC, the flow rate needs to be set using this procedure. This is an informational section. This section is only required as needed.

8.1. Flow Rate Adjustment Procedure

1. Press Menu (exit) to go to MAIN MENU.
2. Scroll to the Measurements menu and press Enter.
3. Select the measurement letter (A, B, C…) for the TOC measurement of interest.
4. Press Page Down (twice) until the "Press 5 for TOC menu" appears.
5. Press enter to activate Set Flow Rate option. Change this setting to Yes. This immediately initiates the Set Flow Rate mode at the sensor. It will stay in this mode until the user changes the "Set Flow Rate: Yes" back to "Set Flow Rate: No". If the user does not set the flow rate once the Set Flow Rate mode has been initiated, the 770MAX will time out, at which time the mode automatically goes back to "Set Flow Rate: No" and the instrument returns to the measurement display screen.
6. See Figure 3. The flow rate is set by adjusting the needle on the 5000TOCe Sensor. NOTE: Clockwise (CW) to decrease flow, counterclockwise (CCW) to increase flow.

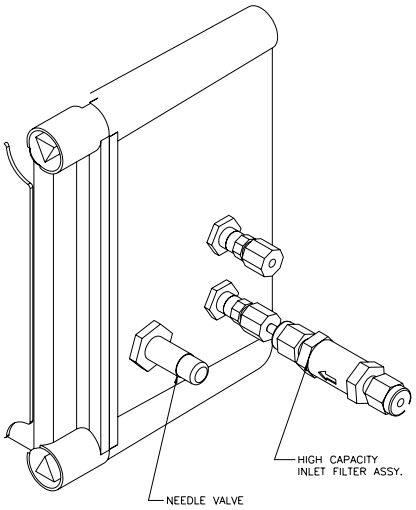

Figure 3. Needle Valve Location

7. In this mode, the LEDs on the front cover of the 5000TOCe Sensor act as a bar-graph indicator as described according to Figure 4.
8. Adjust the inlet Needle Valve until three or four LEDs light on the 770MAX for at least 30 seconds.
9. Go to the 770MAX and change "Set Flow Rate: Yes" to "Set Flow Rate: No". The flow rate setting operation is now complete.

8.2. Flow Rate Indication

The flow rate value is indicated by the four LEDs (lights) on the front of the 5000TOCe Sensor.

Fault	●	
Error	●	
Sensor Status	●	
UV Lamp On	●	

● = LED illuminated O = LED not illuminated

When the flow rate is at 20 mL/min (±2.5%), all four LEDs will be on. This is acceptable.
When the flow rate is at 20 mL/min (±7.5%), the top three LEDs OR the bottom three LEDs will be on. This is acceptable.
If the flow rate is too high, the top two LEDs will be on. Turn the adjustment knob clockwise.
If the flow rate is too low, the bottom two LEDs will be on. Turn the adjustment knob counterclockwise.
If the flow rate is far from 20 mL/min, only the top (Fault) LED or the bottom (UV Lamp) LED will be on.

As the flow rate approaches the an acceptable value, more LEDs will turn on. For example, if the flow rate is too high, as the adjustment knob is turned clockwise, first the Fault LED will be on, then the Fault and Error LEDs will be on, then the Fault, Error and Sensor Status LEDs will be on and finally all four LEDs will be on when the flow rate is 20 mL/min (±2.5%).

	Very LOW	LOW	NEAR SET	SET	NEAR SET	HIGH	Very HIGH
Fault	○	○	○	●	●	●	●
Error	○	○	●	●	●	●	○
Sensor Status	○	●	●	●	●	○	○
UV Lamp On	●	●	●	●	○	○	○

● = LED illuminated ○ = LED not illuminated

Figure 4. LED Indicator for Flow rate

Appendix 1

Installing the Thornton 5000TOCe Calibration Test Kit Brackets

1. Refer to Figure 5. Install Main Bracket A on top of the 5000TOCe Sensor.
2. Attach Main Bracket B onto Main Bracket A with 2 thumbscrews as shown.

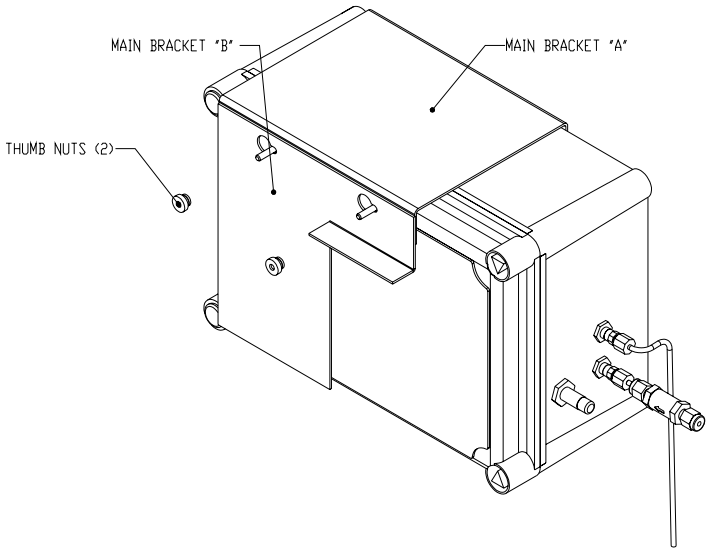

Figure 5

3. Refer to Figure 6. Align the slotted hole in the pump assembly over the left thumb screw, and then slide the pump assembly to the left to hold in position.
4. Align the slotted hole in the Bottle Holder Bracket over the right thumb screw, and then slide the bracket to the left to hold in position.

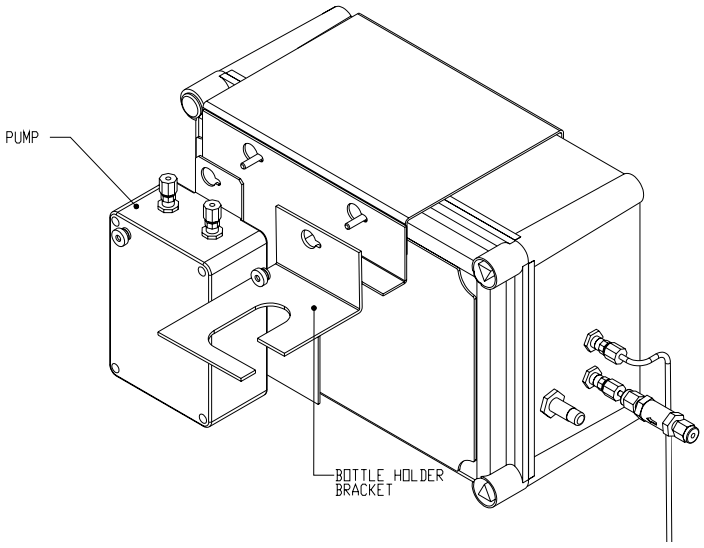

Figure 6

5. Secure the entire assembly by tightening the thumb screws. The entire bracket assembly is now complete and should look like Figure 7.

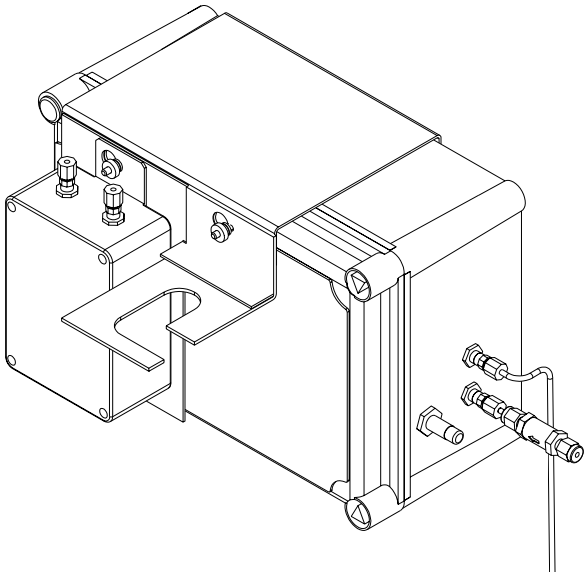

Figure 7

Installing the Thornton 5000TOCe Calibration Kit Tubing

1. See Figure 8. Clean the Transfer Cap assembly using de-ionized or process water (water to be tested).
2. Take one of the Blank Water bottles and shake it to homogenize the contents.
3. Remove the Blank Water bottle cap and replace it with the cleaned Transfer Cap.
4. Slide the Blank Water bottle and Transfer Cap onto the assembled Bottle Holder Bracket.

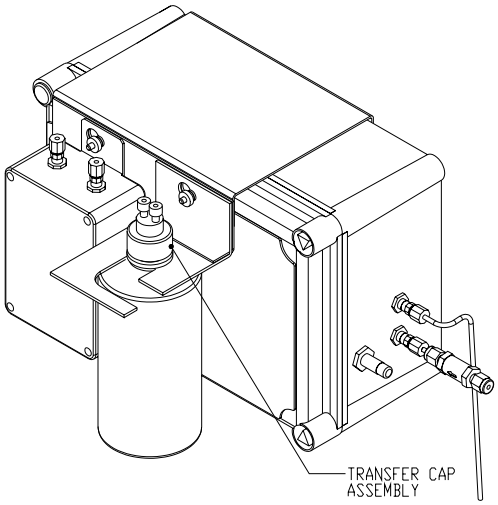

Figure 8

5. See Figure 9. Clean Tube A using de-ionized or process water (water to be tested).
6. Insert one end of Tube A into the Transfer Cap until it comes to approximately 1 cm from the bottom of the Blank Water bottle.
7. Place the other end of Tube A into the "IN" port of the Pump.
8. Connect one end of Tube B to the "OUT" of the Pump.
9. Place the other end of Tube B over a container that can hold at least 100mL of water. Do not allow the end of the tube to become contaminated.

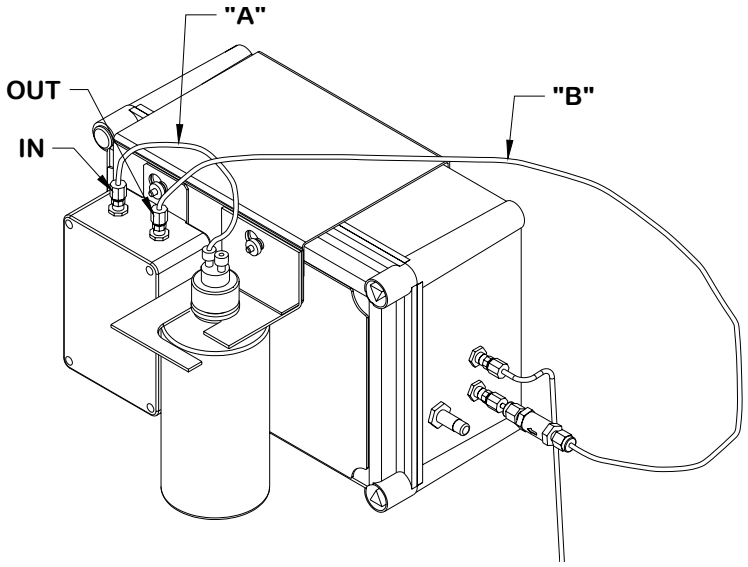

Figure 9

10. Verify the pump switch is in the OFF position.
11. Connect the Universal Power Supply to the pump and to 100–240 VAC 50-60 Hz power. The kit includes a North American AC power cord. Replace or adapt the power cord as necessary and in accordance with local regulations.
12. Turn the pump power switch to ON and operate pump for approximately 2 minutes to remove any residual water from the pump and the 5000TOCe Sensor.
13. Turn the pump OFF.
14. Once the residual water has been successfully purged, connect the exposed end of Tube B to the filter assembly on the Sample Inlet of the 5000TOCe Sensor.
15. Verify the original drain tube is connected to the Sample Outlet of the 5000TOCe Sensor and run to atmospheric drain. It is critical not to re-circulate this solution.
16. Turn the pump power switch to ON. Note water dripping from the sensor discharge tubing at the atmospheric drain. Allow the sensor to purge for at least 5-10 minutes.
17. Turn the pump OFF.
18. Proceed to Section 6: TOC Calibration

NOTE: When the pump is first put into service, or after extended storage, it may need to be primed by injecting reagent water into the inlet fitting with the provided syringe. Place the pump in its normal vertical position with the inlet tube from the bottle removed from the inlet fitting and the outlet tube placed to discharge to a nearby drain or into a container. Draw reagent or clean process water into the syringe, place the tip of the 30 mL syringe into the pump inlet fitting, turn on the pump and push about 10 mL of water into the fitting or until water appears at the outlet fitting. Excess water will run from the inlet fitting. Turn off the pump. Reattach the tube from the bottle to the pump inlet fitting, and proceed. Reagent water, known to be low TOC, is ideal to be utilized for flushing the 5000TOCe Sensor.

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