Functional Checks and Cleaning Methodology for WET Labs Transmissometers

Introduction

Transmissometers measure the light lost across a known distance. The maximum signal for a transmissometer occurs when there is no target between the light source and the receptor. This is a "top down" sensor, where the "blank" value is the highest signal output and any target population causes the signal to decrease. In contrast, the *ECO* line of fluorometers and backscattering sensors are "bottom up," where the signal increases with the concentration of the particular target.

WET Labs calibrates its transmissometers using the cleanest water available, and by convention, subtracts the absorption due to water during the calibration process. Hence, WET Labs' transmissometer signal encompasses the signal due to particles and dissolved materials in the target volume.

For "top down" instruments, the single most important variable in obtaining good data is the cleanliness of the instrument's optical surfaces. This document details how to clean the optical surfaces of the sensor and the best practices for tracking sensor performance over its duty cycle:

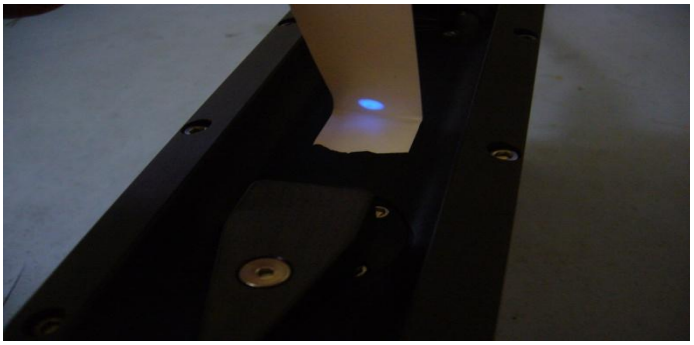
1. When the sensor is received
2. After the sensor is attached to a cage
3. Before being deployed
4. After being deployed.

1. Receipt of sensor

1. Remove the sensor from the shipping container and refer to the user's guide to supply power to the sensor.
   The sensor should be operated in air only.

Caution
Do not touch the optical surfaces.

2. Check the light source with a piece of white paper in the light path. There will be a circle of light of the color specified for the instrument, e.g. red, green or blue. A UV transmissometer will generally cause white paper to fluoresce blue.

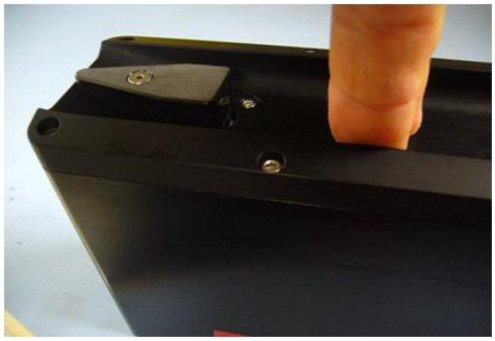


   If there is no light from the sensor, check the power supply. If there is still no light, contact WET Labs Support.

Data is output from the instrument in the order shown:

Column	Value	Example
1	Instrument serial number	CSTR-0000 11829 13838 13695 0.003 527
2	Reference counts	CSTR-0000 11829 13838 13695 0.003 527
3	Signal counts	CSTR-0000 11829 13838 13695 0.003 527
4	Corrected signal raw counts	CSTR-0000 11829 13838 13695 0.003 527
5	Calculated beam c, inverse meters	CSTR-0000 11829 13838 13695 0.003 527
6	Internal thermistor, counts	CSTR-0000 11829 13838 13695 0.003 527

3. Block the light beam, but DO NOT touch the window.
   - The signal count value and the corrected signal raw count value should both be 00000.



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CSTR-2100  12683  00000  00000  99.999 527
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   - The calculated beam c value of 99.999 is not meaningful when the light is blocked.

If the blocked value is more than 50 counts, turn the power supply off and then on again. Look at the data output. If the blocked value is still more than 50 counts, contact WET Labs Support.

4. View the data output with nothing blocking the beam of light.
   The corrected signal counts (CSC_{air}) value should be similar or equal to the CSC_{air} value on the sensor's calibration sheet or calibration log.

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CSTR-0000  12681  12977  12966  0.551  527
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Clean air values will only be similar or equal to the calibration sheet values in a clean, controlled environment.

1.1 Criteria for CSC_{air}

Refer to the sensor's calibration sheet that comes from the manufacturer or the most recent calibration value from a user-maintained log to get the most recent CSC_{air} value.

If the CSC_{air} output of the sensor is within 100 counts:

1. Optionally clean the optical surfaces.
2. Record the sensor's output on the Transmissometer Air Calibration log or a similar document.

If the CSC_{air} output of the sensor is more than 100 but less than 500 counts:

1. Clean the optical surfaces. Refer to section 6 for the cleaning procedure.
2. Repeat the cleaning procedure until—
   - CSC_{air} is within 100 counts or less, or
   - CSC_{air} is between 100 and 500 counts but the output is stable.
3. Record the sensor's output on the Transmissometer Air Calibration log or a similar document.

If the CSC_{air} output is more than 500 counts:

1. Clean the optical surfaces. Refer to section 6 for the cleaning procedure.
2. Repeat the cleaning procedure until—
   - CSC_{air} is within 100 counts or less, or
   - CSC_{air} is between 100 and 500 counts but the output is stable.
3. Record the sensor's output on the Transmissometer Air Calibration log or a similar document.

If the sensor's data output is not within 500 counts of the last factory calibration, contact WET Labs Support. The sensor may have to be returned for re-calibration or repair.

2. Post-installation:

Once the user has attached the sensor to onto a cage or other type of deployment, check the CSC_{air} value using the power system that will be used for deployment. The sensor should be in air only. Do NOT touch the optical surfaces.

2.1 Criteria for CSC_{air}

Refer to the sensor's calibration sheet that comes from the manufacturer the most recent calibration value from a user-maintained log to get the most recent CSC_{air} value.

If the CSC_{air} output of the sensor is within 100 counts:

1. Optionally clean the optical surfaces.
2. Record the sensor's output on the Transmissometer Air Calibration log or a similar document.

If the CSC_{air} output of the sensor is more than 100 but less than 500 counts:

1. Clean the optical surfaces. Refer to section 6 for the cleaning procedure.
2. Repeat the cleaning procedure until—
   a. CSC_{air} is within 100 counts or less, or
   b. CSC_{air} is between 100 and 500 counts but the output is stable.
3. Record the sensor's output on the Transmissometer Air Calibration log or a similar document.

If the CSC_{air} output is more than 500 counts:

1. Clean the optical surfaces. Refer to section 6 for the cleaning procedure.
2. Repeat the cleaning procedure until—
   a. CSC_{air} is within 100 counts or less, or
   b. CSC_{air} is between 100 and 500 counts but the output is stable.
3. Record the sensor's output on the Transmissometer Air Calibration log or a similar document.

If the sensor's data output is not within 500 counts of the last factory calibration, contact WET Labs Support. The sensor may have to be returned for re-calibration or repair.

3. Pre-deployment

Disregard this check if the sensor is installed and deployed at the same time. Many times cages are put together long before being deployed, so the sensor needs to be checked again before being deployed. The sensor should be in air only. Do NOT touch the optical surfaces.

3.1 Criteria for CSC_{air}

Refer to the sensor's calibration sheet that comes from the manufacturer the most recent calibration value from a user-maintained log to get the most recent CSC_{air} value.

If the CSC_{air} output of the sensor is within 100 counts:

1. Optionally clean the optical surfaces.
2. Record the sensor's output on the Transmissometer Air Calibration log or a similar document.

If the CSC_{air} output of the sensor is more than 100 but less than 500 counts:

1. Clean the optical surfaces. Refer to section 6 for the cleaning procedure.
2. Repeat the cleaning procedure until—
3. CSC_{air} is within 100 counts or less, or
4. CSC_{air} is between 100 and 500 counts but the output is stable.
5. Record the sensor's output on the Transmissometer Air Calibration log or a similar document.

If the CSC_{air} output is more than 500 counts:

4. Clean the optical surfaces. Refer to section 6 for the cleaning procedure.
5. Repeat the cleaning procedure until—
6. CSC_{air} is within 100 counts or less, or
7. CSC_{air} is between 100 and 500 counts but the output is stable.
8. Record the sensor's output on the Transmissometer Air Calibration log or a similar document.

If the sensor's data output is not within 500 counts of the last factory calibration, contact WET Labs Support. The sensor may have to be returned for re-calibration or repair.

4. Post-deployment

4.1 Rinse the sensor

When the sensor is removed from the water, rinse the optical surfaces with clean water. Any clean water source is adequate to remove loose material and salt water from the sensor. Dry the optical surfaces with clean air.

It is more important to record the start value prior to the next deployment than to do an air calibration after every use of the instrument. The data should be used to judge if further cleaning is needed. The primary question should be: is the data reasonable?

4.2 Clean the sensor

After all the optical surfaces have been cleaned and dried using the cleaning procedure in this

document, the instrument output should be recorded.

Note that the cleaning procedure may have to be done multiple times depending on how fouled the sensor is. Use this air value to track the senor's output to determine long-term drift and in particular when to return the sensor for service.

Note that a post-deployment air calibration does not determine the validity of the data during deployment due to possible changes to the optical surfaces. Generally, it is difficult to estimate drift of the instrument due to fouling after the instrument is removed from the environment.

4.2.1 Clean Air Check Criteria

If the sensor's data output varies more than 500 counts from the last factory calibration, contact WET Labs Support. The sensor may have to be returned for re-calibration or repair.

5. Clean the optical surfaces

5.1 Supplies

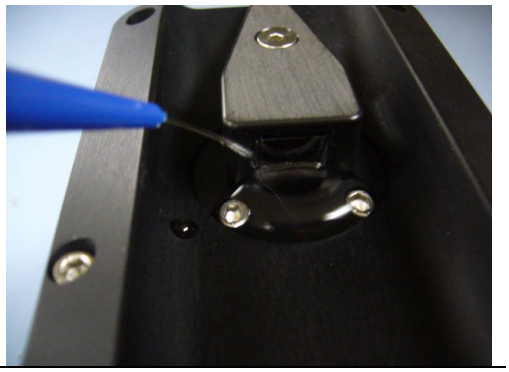
WET Labs recommend a maintenance kit of the items below:

- 2 squirt bottles, 500 ml
  - one for clean water, one for detergent solution
- De-ionized (DI) or Reverse Osmosis (RO) water
- A commercial detergent such as Microclean or Dawn
  - 2 drops of detergent in a 500 ml squirt bottle filled with 0.2 or 0.4 µm filtered distilled and de-ionized water is sufficient.
  - 10–20 drops of detergent in water as above for heavily fouled surfaces.
- Lint-free laboratory wipes (i.e. Kimwipes) and/or lens paper
- Lint resistant swab (polyurethane-tipped)
- Pressurized sources, in order of most- to least-effective
  - Clean dry nitrogen
  - Clean dry air
  - Canned air
- A notebook for recording maintenance dates and tracking output.

5.2 Cleaning Procedure

The user will generally need to do this cleaning procedure several times to get a stable clean air value.

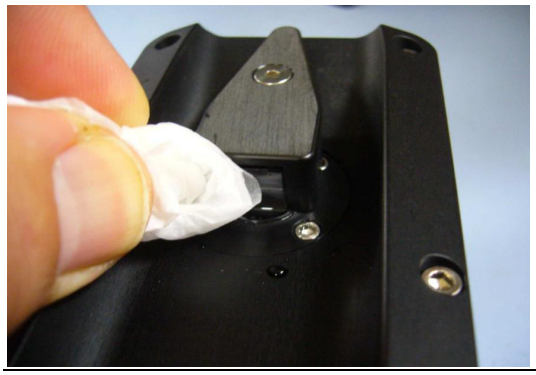
1. Squirt a small amount of a dilute solution of detergent onto the optical surface of the exposed glass cube to break surface tension on the optical face and dislodge particles and minor surface oils.

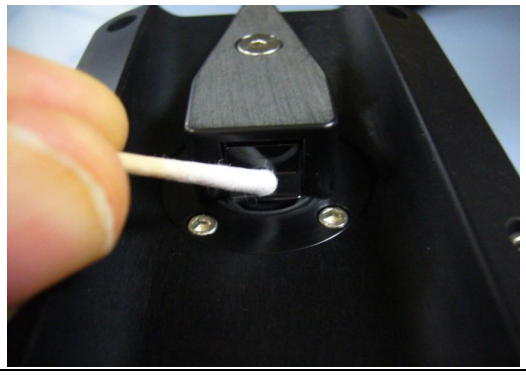


! Unfiltered DI water may leave some particles on optical surfaces.

! If the instrument is severely fouled, clean using a standard detergent solution first and then the dilute solution.

2. Use a lint-free laboratory wipe or swab to gently dab/tap the optical surface to remove particles and fouling films while the optical face is wet. Do not allow any fibers to remain on the optical surface.





Caution

If using canned air, be careful not to spray propellant on the optical surfaces. Spray should be started away from the sensor to clear any liquid from the spray nozzle.

3. Spray dry nitrogen to dislodge any particulates and to dry the optical surface.

Appendix: Tracking Worksheet Examples:

Functional Air Checks					
	Test 1	Test 2	Test 3	Test 4	Test 5
Serial Number:					
Corrected Signal Clean (CSCair) Calibration:					
Cal Date:					
CSCair Incoming:					
Offset:					
Test and Data Log Recorded By:					
Date:					
CSCair Post installation:					
Offset:					
Test and Data Log Recorded By:					
Date:					
CSCair Pre-Deployment Test:					
Offset:					
Test and Data Log Recorded By:					
Date:					
CSair Post-Deployment Rinsed Test:					
Offset:					
Test and Data Log Recorded By:					
Date:					
CSCair Post-Deployment Cleaned Test:					
Offset:					
Test and Data Log Recorded By:					
Date:					

WET Labs®

Transmissometer Air Calibration Log

Serial Number: _____

Date Purchased: _____

Date	Reference Counts	Raw Signal Counts	Corrected Signal Counts	beam c m^{-1}	Internal Temp Counts	Operator	Notes

Revision History

Revision	Date	Revision Description	Originator
1	4/30/12	New document (DCN 795)	J. Koegler, I. Walsh