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APPLICATION NOTE NO. 87 **Revised May 2011**

Calculating Calibration Coefficients for WET Labs ECO-BB Scattering/Turbidity Meter (voltage or RS-232 output sensor)

Note: Procedures in this application note are valid for Seasave V7 and SBE Data Processing version 7.21d and later.

This Application Note applies to the use of the WET Labs ECO-BB series of scattering/turbidity meters with Sea-Bird CTDs. The ECO-BB has a response that is linear over the measurement range provided.

The type of output available from the ECO-BB has varied:
- Products **currently** sold by WET Labs:
  - ECO-BB, 0 – 5 m^{-1} sr^{-1} range: WET Labs provides a calibration sheet for calculation of output in m^{-1} sr^{-1}.
- **Older products** sold by WET Labs:
  - ECO-BB, 0 – 25 NTU range: WET Labs provided **two** calibration sheets, for calculation of output in NTU **or** m^{-1} sr^{-1}, as desired by the user.
  - ECO-BB, 0 – 100 NTU range: WET Labs provided a calibration sheet for calculation of output in NTU only.

Note: If you require NTU output in a currently manufactured product, WET Labs ECO-NTU or ECO-FLNTU is calibrated for calculation of output in NTU. See *Application Note 62*.

Each calibration sheet provides a *Dark Outputs* and *Scale Factor* consistent with the output units. Definition of the sensor in Sea-Bird software follows for m^{-1} sr^{-1} and NTU (NTU output available only for older ECO-BB meters).

Notes:
- The ECO-BB comes with a calibration sheet that lists values for Dark Outputs and Scale Factor. Each of these values is supplied in terms of both voltage and counts.
  - Use the **voltage values** in the Sea-Bird software if using a **voltage output ECO-BB**.
  - Use the **counts values** in the Sea-Bird software if using an **RS-232 output ECO-BB** (compatible only with SBE 16*plus* V2, 16*plus*-IM V2, or 19*plus* V2 CTDs).
- The ECO-BB is also available as part of the WET Labs Triplet, an RS-232 output instrument that incorporates three WET Labs ECO sensors. The Triplet can include up to three ECO-BB sensors (or an ECO-BB in combination with other ECO sensors). The Triplet is compatible only with the SBE 16*plus* V2, 16*plus*-IM V2, or 19*plus* V2 CTDs. Set up each RS-232 output channel with the coefficients from the calibration sheet for the sensor on that channel.

Setting Up Configuration File for Calibration Coefficients in m^{-1} sr^{-1}

1. Use the Configure Inputs menu in Seasave V7 (real-time data acquisition software), or the Configure menu in SBE Data Processing (post-processing software), to create / modify the .xmlcon file (see software Help files).
   - For the voltage (analog) output ECO BB: Select *OBS/Nephelometers/Turbidity – Turbidity Meter, WET Labs, ECO-BB* for one of the **external voltage channels** on the CTD.
   - For the RS-232 (digital) output ECO BB (SBE 16*plus* V2, 16*plus*-IM V2, or 19*plus* V2 CTDs only): Select *Turbidity Meters – Turbidity Meter, WET Labs, ECO-BB* for one of the **RS-232 channels** on the CTD.

2. The software prompts for Scale Factor and Dark Output, and calculates:
   $\beta(\theta c)$ = (Output – Dark Output) * Scale Factor ($\beta(\theta c)$ in units of m^{-1} sr^{-1})
   where:
   - Output (volts for analog output sensor; counts for digital output sensor) = *in-situ* output of ECO-BB
   - Dark Output (volts for analog output sensor; counts for digital output sensor)
     = measured output for a seawater blank (pure, de-ionized water) with black tape over detector
   - Scale factor ($\beta(\theta c)$/volts for analog output sensor; ($\beta(\theta c)$/counts for digital output sensor) = multiplier

Note: The configuration file can only be saved as an .xmlcon file (not a .con file) if the ECO-BB is one of the sensors.

Setting Up Configuration File for Calibration Coefficients in *NTU* (only for older ECO-BB; purchase ECO-NTU or ECO-FLNTU for sensors currently sold by WET Labs that provide NTU output)

To get NTU units, select the ECO-NTU instead of the ECO-BB in the Sea-Bird software.

1. Use the Configure Inputs menu in Seasave V7 (real-time data acquisition software), or the Configure menu in SBE Data Processing (post-processing software), to create / modify the .xmlcon file (see software Help files).

2. Select *OBS/Nephelometers/Turbidity – Turbidity Meter, WET Labs,* ***ECO-NTU*** for one of the **external voltage channels** on the CTD when editing the configuration file. The software prompts for Dark Output and Scale Factor, and calculates concentration as:
   turbidity (NTU) = (Output – Dark Output) * Scale Factor
   where:
   Output (volts) = *in-situ* output of the turbidity meter
   Dark Output (volts) = measured output for a seawater blank (pure, de-ionized water) with black tape over detector
   Scale factor (NTU/volts) = multiplier

Note:
The configuration file can only be saved as an .xmlcon file (not a .con file) if the ECO-NTU is one of the sensors.

Field Calibrations

While the factory-supplied Scale Factor can be used to obtain approximate values, field calibration is highly recommended. The relationship between ECO-BB output and $\beta(\theta c)$ or turbidity is somewhat variable, and is not easy to determine in the laboratory. Particle shape and size are some of the factors that affect the relationship. To accurately measure with the ECO-BB, perform calibrations on seawater samples with distributions of particles that are similar to what is expected *in-situ*. Determine $\beta(\theta c)$ or turbidity independently, and use those values, as well as readings from the ECO-BB, to determine the correct Scale Factor. **The Scale Factor is correct as long as the distribution of particle sizes and shapes does not change; the condition does change with season and geographic location.**

Application Note Revision History

Date	Description
May 2007	Initial release.
March 2010	• WET Labs changes: Until recently, there was only ECO-BB, for both NTU & m^{-1} sr^{-1}. Now they have different products for different units: - ECO-BB now only for m^{-1} sr^{-1} (calibrated 0-to-5 m^{-1} sr^{-1}). - ECO-NTU for NTU; ECO-NTU can have secondary calibration to m^{-1} sr^{-1} for extra charge. • Add information on .xmlcon configuration file. • Update Sea-Bird address.
August 2010	SBE Data Processing and Seasave 7.20g software revision: • Wet Labs ECO-BB added to list of OBS/Nephelometers/Turbidity sensors (previously needed to select User Polynomial for this sensor). • Also, for older ECO-BB meters outputting in NTU: Wet Labs ECO-NTU added to list of OBS/Nephelometers/Turbidity sensors (previously needed to select User Polynomial for this sensor).
May 2011	SBE Data Processing and Seasave 7.21d software revision: WET Labs RS-232 output sensors, including WET Labs Triplet, are compatible with RS-232 sensor channel on SBE 16*plus* V2, 16*plus*-IM V2, and 19*plus* V2 CTDs.