[www.seabird.com](www.seabird.com)   |   +1 425-643-9866

# Calculating Calibration Coefficients for ECO-bb Scattering/Turbidity Sensors

*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 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:
- ECO-BB, 0 – 5 range: output in $m^{-1} sr^{-1}$.
- ECO-BB, 0 – 25 NTU range: output in NTU **or** $m^{-1} sr^{-1}$, as desired by the user.
- ECO-BB, 0 – 100 NTU range: output in NTU only.

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

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 sensors).

- 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 **RS232 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 ECO Triplet, an RS232 output sensor 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 RS232 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 or modify the .xmlcon file (see software Help files).
   - For the analog (voltage) 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 digital (RS232) 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 **RS232 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 sensors; purchase the ECO-NTU or ECO-FLNTU for sensors 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.**