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# Backscattering Sensor Calibration Sheet

Date: 8/1/2019
Wavelength: 700 nm

S/N SEAOWLA2K-0144

Backscattering intensity as Beta, $m^{-1}$ $sr^{-1}$, can be derived using the equation:

$$\beta(\theta_c)\ m^{-1}\ sr^{-1} = \text{Scale Factor} \times (\text{Output} - \text{Dark Counts})$$

| | | | | | |
|---|---|---|---|---|---|
| Dark counts, this characterization | | | | 49 | counts |
| Dark counts Range | min: | 46 | max: | 52 | counts |
| Scale Factor (SF) | | | | 3.319E-07 | $m^{-1}$ $sr^{-1}$ $count^{-1}$ |
| Resolution | | 1.6 counts | | 5.45E-07 | $m^{-1}$ $sr^{-1}$ |
| Standard Error as % of Scale Factor | | | | 0.30 | % |
| Specified Range: | | | min: | 0.04 | $m^{-1}$ $sr^{-1}$ |
| Maximum Output (see note below) | | | | 5.31E-02 | $m^{-1}$ $sr^{-1}$ |

- **Output**: Signal output of the instrument.
- **Dark Counts**: The average in counts of 1 minute of collected data after 15 minutes of warm-up obtained by covering the detector with the black tape and submersing the sensor in a grounded water bath. The characterization dark counts value is not expected to be the same as the dark counts after integration. Use the dark counts measured after integration for data processing.

- **Dark Counts Range**: Minimum and maximum values recorded in the data collected to determine the dark count value.
- **Scale Factor**: The slope of the linear regression of the target addition series comparing this instrument to a reference instrument.
- **Resolution:** Standard deviation in counts of the data collected to determine the dark counts presented as counts and engineering units by muliplying by the scale factor. For standard deviations of less than one count, resolution is the same as the scale factor.

- **Maximum Output**: Maximum potential scaled output of the instrument. This value is generally greater than the specified range.

## Characterization Methodology:

We perform a multipoint linear regression analysis of the output of this instrument to the output of a calibrated reference instrument using an additive sequence of increasing loadings of polystyrene beads. The goodness of fit is determined by the standard error which must be less than 1% of the scale factor.

The reference units are calibrated to backscattering by simultaneously measuring the reference instrument backscattering signal and the beam attenuation coefficient using an ac meter on an additive series of 0.1 um beads. A linear regression between the backscattering signal and the beam $c_p$ yields b $count^{-1}$ assuming that absorption by the beads is negligible. Conversion from b $count^{-1}$ to $\beta(\theta c)$ involves multiplying the b $count^{-1}$ value by an instrument and bead and wavelength specific normalized volume scattering coefficient. The normalized volume scattering coefficient includes the instrument scattering centroid angle ($\theta c$) and the weighting function $W(\theta,\theta c)$ computed by the numerical integration of sample volume elements according to the sensor geometry, as well as the normalized scattering phase functions $\beta(\theta,\lambda)/b(\lambda)$ for the calibration bead dispersion by weighing volume scattering functions computed from Mie theory according to the known size distribution of the bead dispersion.

## Note on Maximum Output:

The maximum number of counts that the instrument can output is approximately 160,000. In most natural waters the potential range of the instrument is greater than the measurable range due to interference factors, e.g. the absorbance length scale. Caution should be used for data sets in which the reported values exceed the specified range. Grab samples should be used to confirm values above the specified range.