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Scattering Meter Calibration Sheet

May 26, 2006 Customer: MBARI
Wavelength: 700 S/N#: FLNTUS-518 Job #: 605058 Tech: c.w.

Use the following equation to obtain either digital or analog "scaled" output values:

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

• **Scale Factor for 700 nm**	=	1.76E-05	(counts)	1.44E-02	(volts)
• **Output**	=	meter output	(counts)	meter output	(volts)
• **Dark Counts**	=	43	(counts)	0.053	(volts)
Instrument Resolution	=	1.2	(counts)	2.04E-05	($m^{-1}\ sr^{-1}$)
		1.0	(volts)		

Definitions:

- **Scale Factor**: Calibration scale factor, $\beta(\theta c)$/counts. Refer to User's Guide for derivation.
- **Output**: Measured signal output of the scattering meter.
- **Dark Counts**: Signal obtained by covering detector with black tape and submersing sensor in water.

Instrument Resolution: Standard deviation of 1 minute of collected data.

1. For each scattering centroid angle (θc), we compute the weighting function $W(\theta,\theta c)$, by numerical integration of sample volume elements according to the sensor geometry.

2. We determine scattering phase functions, $\beta(\theta,\lambda)/b(\lambda)$, for the microsphere calibration particles by weighing volume scattering functions computed from Mie theory according to the known size distribution of the microsphere polydispersion and normalizing to total scattering.

3. By convolving $W(\theta,\theta c)$ with $\beta(\theta,\lambda)/b(\lambda)$, we then compute the normalized volume scattering coefficient for each measurement angle, $\beta(\theta,\lambda)/b(\lambda)$, with units of 1/sr: **β(θc)/b for 2.00 micron diameter beads**.

	Wavelength, λ (nm)
Angle, θc	**700**
117	**0.0027206**

4. We then experimentally obtain raw scattering counts simultaneously with attenuation coefficients (Cp, using an ac-9) for a concentration series of the bead polydispersion. Absorption by the calibration particles is assumed negligible.
Results for this instrument follow:

		raw counts, 117	
	Cp700	**Digital**	**Analog**
		43.0000	0.0530
Clean water	0.3295	58.8611	0.0670
	0.3496	93.9744	0.1080
	0.7663	163.8333	0.1960
	1.4398	260.8378	0.3130
	2.0888	354.7500	0.4290
	2.7802	456.7778	0.5520
	3.5476	576.0000	0.7020

Dark Counts: obtained by covering detector with black tape and submersing sensor in water.

5. We obtain b/counts from the slope of a linear regression between Cp (equivalent to b for the beads) and counts:

	117			
slope, intercept	**0.00647**	-0.20157	**5.27487**	-0.16912
	0.00018	0.06126	0.14848	0.05977
r	0.99596	0.08679	0.99605	0.08577

6. Multiplying the experimental b/counts by the theoretical $\beta(\theta c)/b$ yields the calibration scaling factor, S:

	S		
digital	**1.7601E-05**	**analog**	**1.4351E-02**

To obtain $\beta(\theta c)$, 1) subtract the dark counts (see step 4) from the raw counts measured, then 2) multiply by **S** from the table above.

7. The test also provides a measure of the inherent noise level of the instrument from the short term RMS deviation from the average number of counts. We translate this into the resolution of $\beta(\theta c)$ (minimum detectable signal change) in units of 1/(m. steradians).

Noise (counts)	1.157905766	**Resolution (1/[m. ster])**
Noise (volts)	1.0312	2.038E-05

	#VALUE!	#VALUE!
	#VALUE!	#VALUE!
noise limit	3	4