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Volume Scattering Function Calibration Sheet

Date 3/18/2003	Customer	Emmanuel Boss			
Wave 440nm	S/N#	vsf-005b		Tech	K.C.

1. From the design, we compute the weighting function for each scattering angle for each light source by numerical interaction of the sample volume elements.

2. We determine the volume scattering functions for the calibration particles by integrating the MIE scattering functions over the size distribution.

3. We compute the portion of the total scattering coefficient for the calibration particles represented by the angular weighting functions. We then divide this by the solid angle in steradians represented by the weighting factors to get $\beta(\theta)/b$ as shown below:

$\beta(\theta)/b$ for 1.96 Micron Diameter Beads

	Wavelength		
Angle Centroid	**440**	530	650
100	**0.00786**	0.00500	0.00287
125	**0.01079**	0.00528	0.00257
150	**0.00864**	0.00354	0.00167

4. For each instrument, we obtain the scattering signals and the attenuation coefficients for a dilution series of 2-micron beads. The results for this instrument follow:

		Counts		
	Cp440	**100**	**125**	**150**
Dark counts		123.563	128.063	166.094
Clean water	0.014	129.419	167.065	150.774
	0.168	149.133	177.733	214.367
	0.263	162.167	202.333	252.667
	0.395	180.000	236.563	304.938
	0.745	231.516	333.161	457.968
	1.129	283.633	438.433	617.567
	1.510	337.968	540.065	768.839
	1.904	393.906	646.000	929.094

5. It is assumed that Cp is equal to b for the calibration particles. We obtain b/counts by linear regression.

	100	
slope, intercept	**0.007134**	**-0.898658**
	4.24487E-05	0.00943685
r	**0.999823**	0.00801421

	150	
slope, intercept	**0.002404**	**-0.346900**
	1.43E-05	0.00639492
r	**0.999824**	0.00798946

	125	
slope, intercept	**0.003813**	**-0.538067**
	0.000128031	0.04194394
r	**0.994396**	0.045098

6. Multiplying b/counts by $\beta(\theta)/b$ yields:

	$\beta(\theta)$ /counts
100	**5.607E-05**
125	**4.115E-05**
150	**2.077E-05**

7. Dividing intercept by slope yields

Dark Counts
123.563
128.063
166.094

To obtain $\beta(\theta)$, subtract the zero offset from the counts obtained, then multiply by $\beta(\theta)$/counts from the table above.

8. 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 $\beta(\theta)$ (minimum detectable signal change) in units of 1/m. steradians).

Noise (counts)		**Resolution (1/[m. ster])**
100	1.7964	1.01E-04
125	1.9006	7.82E-05
150	1.9268	4.00E-05

Volume Scattering Function Calibration Sheet

Date: **4/25/02** **Serial # VSF-006G** **Wavelength:** **530 nm** **Tester:** **Dan**

Test Description

1. From the design, we compute the weighting function for each scattering angle for each light source by numerical integration of the sample volume elements.
2. We determine the volume scattering functions for the calibration particles by integrating the MIE scattering functions over the size distribution.
3. We compute the portion of the total scattering coefficient for the calibration particles represented by the angular weighting functions. We then divide this by the solid angle in steradians represented by the weighting factors to get $\beta(\theta)$ /b as shown below:

$\beta(\theta)$ /b for 1.96 Micron Diameter Beads

	Wavelength		
Angle Centroid	440	**530**	650
100	0.00786	**0.00500**	0.00287
125	0.01079	**0.00528**	0.00257
150	0.00864	**0.00354**	0.00167

4. For each instrument, we obtain the scattering signals and the attenuation coefficients for a dillution series of 2 micron beads. The results for this instrument follow:

		Counts		
	Cp530	100	125	150
Dark Counts		128.600	127.716	132.900
Clean water	0.004	133.250	135.233	150.516
	1.202	326.950	364.166	524.433
	2.285	502.766	570.966	856.516
	3.397	682.050	780.750	1193.483
	4.507	861.516	990.500	1525.683

5. It is assumed that Cp is equal to b for the calibration particles. We obtain b/counts by linear regression.

	100	
slope, intercept	**0.006183**	**-0.820484**
	3.43245E-06	0.001932
r	**0.999999**	0.001967

	150	
slope, intercept	**0.0032752**	**-0.505311**
	1.581E-05	0.015464
r	**0.9999301**	0.0171

	125	
slope, intercept	**0.005266**	**-0.713561**
	9.47168E-06	0.006091
r	**0.999990**	0.006372

6. Multiplying b/counts by $\beta(\theta)$ /b yields: 7. Dividing intercept by slope yields

	$\beta(\theta)$ /counts	**Dark Counts**
100	**3.091E-05**	**128.600**
125	**2.780E-05**	**127.716**
150	**1.159E-05**	**132.900**

To obtain $\beta(\theta)$, subtract **the zero offset** from the counts obtained, then multiply by **$\beta(\theta)$ /counts** from the table just above.

8. 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 $\beta(\theta)$ (minimum detectable signal change) in units of 1/(m. steradians).

	Noise (counts)	**Resolution (1/(m. ster))**
100	0.9014	2.79E-05
125	0.8105	2.25E-05
150	0.7718	8.95E-06

Volume Scattering Function Calibration Sheet

Date: **12/19/00** **Serial # VSF004R** **Wavelength:** **650 nm** **Tester:** **Christian**

Test Description

1. From the design, we compute the weighting function for each scattering angle for each light source by numerical integration of the sample volume elements.
2. We determine the volume scattering functions for the calibration particles by integrating the MIE scattering functions over the size distribution.
3. We compute the portion of the total scattering coefficient for the calibration particles represented by the angular weighting functions. We then divide this by the solid angle in steradians represented by the weighting factors to get β(θ) /b as shown below:

β(θ) /b for 2 Micron Diameter Beads

	Wavelength		
Angle Centroid	440	530	**650**
100	0.0076	0.0054	**0.0030**
125	0.0115	0.0060	**0.0028**
150	0.0095	0.0040	**0.0017**

4. For each instrument, we obtain the scattering signals and the attenuation coefficients for a dilution series of 2 micron beads. The results for this instrument follow:

		Counts		
	Cp650	100	125	150
Air		135.1667	138.7619	145.5714
Clean water	0.008	170.1636	165.8909	189.6909
	1.667	483.5082	425.3934	603.5738
	3.669	888.5667	758.3833	1168.383
	5.047	1171.517	986.5	1520.767
	6.54	1494.783	1241.717	1950.55

5. It is assumed that Cp is equal to b for the calibration particles. We obtain b/counts by linear regression.

	100	
slope, intercept	0.004930	-0.763034
	6.68477E-05	0.064529
r	0.999449	0.070642

	125	
slope, intercept	**0.006063**	**-0.952547**
	5.14423E-05	0.041783
r	**0.999764**	0.044205

	150	
slope, intercept	**0.0037029**	**-0.637293**
	4.741E-05	0.059527
r	**0.9995085**	0.0667

6. Multiplying b/counts by β(θ) /b yields:

	β(θ) /counts
100	**1.479E-05**
125	**1.698E-05**
150	**6.295E-06**

7. Dividing intercept by slope yields **the zero offset**

100	**155**
125	**157**
150	**172**

To obtain β(θ), subtract **the zero offset** from the counts obtained, then multiply by **β(θ) /counts** from the table just above.

8. 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 β(θ) (minimum detectable signal change) in units of 1/(m. steradians).

	Noise (counts)	**Resolution (1/(m. ster))**
100	0.889	1.31E-05
125	0.854	1.45E-05
150	0.833	5.24E-06