The National Marine Biological Analytical Quality Control Scheme

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Particle Size Results – PS55

Lydia Finbow and David Hall
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Email: nmbaqc@apemltd.com

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PARTICLE SIZE EXERCISE DETAILS

Particle Size (PS) #55

Type/Contents/Origin/Pre-treatments:

- **~50g dried sand (Swanage) <0.5 mm pre-sieve**
- **800g Gravel (aggregate source) @ various prescribed ½ phi categories**
- **500g wet mud (Barry Island)**
- **200g of water to mix.**

Phi category/ sediment type		Approximate weight in grams
Gravel	3.5 to -3.0	415
	-3.0 to -2.5	340
	2.5 to -2.0	40
	-2.0 to -1.5	5
Sand		50 dried
Mud		500 wet

Circulated: **18/012/2014**

Completion Date: **06/02/2015**

Number of Subscribing Laboratories: **15**

Number of Participating Laboratories: **13**

Number of Results Received: **14***

* One sample from PSA_2113 was stored frozen on arrival, due to lack of information on storage and to samples arriving during Christmas break. A replacement sample was later provided, which was not frozen. PSA_2113 is the non-frozen sample and PSA_2113_a is the data from the frozen sample.

Table 1. Summary of the methodology and sieve metadata information received from participating laboratories and replicate analysis laboratory for the fifty-fifh particle size distribution - PS55.

Benchmark	Method	Sieves used	Phi; sieve mesh		Total Weight (g)
			Weight (g) < 0.00; >1 mm	Weight (g) > 0.00; <1 mm	
REPLICATE 1	NMBAQC	☑	728.96	179.48	908.44
REPLICATE 2	NMBAQC	☑	724.28	185.39	909.67
REPLICATE 3	NMBAQC	☑	749.04	187.55	936.59
REPLICATE 4	NMBAQC	☑	733.71	183.52	917.23
REPLICATE 5	NMBAQC	☑	734.61	181.36	915.97
BM AVERAGE	NMBAQC	☑	734.12	183.46	917.58

Participant	Method	Sieves used	Phi; sieve mesh		Total Weight (g)
			Weight (g) < 0.00; >1 mm	Weight (g) > 0.00; <1 mm	
PSA_2101	NMBAQC	☑	759.97	194.63	954.60
PSA_2102	NMBAQC	☑	724.08	183.08	907.16
PSA_2103	NMBAQC	☑	795.21	199.92	995.13
PSA_2105	NMBAQC	☑	728.96	179.48	908.44
PSA_2106	NMBAQC	☑	81.3415	0.00	81.3415
PSA_2107	NMBAQC	☑	791.70	179.90	971.60
PSA_2108	NMBAQC[1]	☑	792.19	196.62	988.81
PSA_2109	OTHER	☑	794.08	217.13	1011.21
PSA_2110	NMBAQC	☑	790.87	192.05	982.92
PSA_2111	OTHER	☑	800.12	503.8	1303.92
PSA_2112	NMBAQC	☑	778.22	190.54	968.76
PSA_2113	NMBAQC	☑	792.13	197.19	989.32
PSA_2113_a	NMBAQC	☑	791.36	191.59	982.95
PSA_2114	NMBAQC	☑	752.08	188.96	941.04

Key to methods

NMBAQC - NMBAQC PSA SOP for supporting biological data

NMBAQC[1] - NMBAQC PSA SOP for supporting biological data - incorporating BS1377: 1990 Parts 1-2 (sieving) and BS13320: 2009 (laser diffraction)

BLUE TEXT = amended after interim report

Table 2. Summary of the <1mm; >0.00 phi laser metadata received from participating laboratories and replicate analysis laboratory for the fifty-fifth particle size distribution - PS55.

		% Sand				% Silt				% Clay
Benchmark	Laser Used	Coarse 0 - 1 phi	Medium 1 - 2 phi	Fine 2 - 3 phi	Very Fine 3 - 4 phi	Coarse 4 - 5 phi	Medium 5 - 6 phi	Fine 6 - 7 phi	Very Fine 7 - 8 phi	8 - 13 phi
REPLICATE 1	☑	0.00	5.47	8.85	4.19	6.48	11.44	14.66	17.19	31.72
REPLICATE 2	☑	0.00	5.56	8.65	3.90	6.56	11.51	15.33	17.90	30.60
REPLICATE 3	☑	0.00	4.83	9.55	4.13	6.36	11.26	14.81	17.52	31.54
REPLICATE 4	☑	0.00	5.17	9.67	4.68	6.51	11.27	14.93	17.52	30.25
REPLICATE 5	☑	0.00	4.76	9.96	3.75	6.42	11.59	14.70	17.17	31.65
BM AVERAGE	☑	0.00	5.16	9.34	4.13	6.46	11.41	14.89	17.46	31.15

		% Sand				% Silt				% Clay
Participant	Laser Used	Coarse 0 - 1 phi	Medium 1 - 2 phi	Fine 2 - 3 phi	Very Fine 3 - 4 phi	Coarse 4 - 5 phi	Medium 5 - 6 phi	Fine 6 - 7 phi	Very Fine 7 - 8 phi	8 - 13 phi
PSA_2101	☑	0.76	8.02	10.92	5.91	7.05	10.71	15.00	15.91	25.73
PSA_2102	☑	1.01	6.22	5.24	2.19	8.29	14.33	20.30	22.91	19.51
PSA_2103	☑	3.46	24.03	14.51	6.98	13.06	12.53	9.41	7.01	9.04
PSA_2105	☑	0.00	5.47	8.85	4.19	6.48	11.44	14.66	17.19	31.72
PSA_2106 *	☑	1.49	2.48	0.92	0.92	1.93	2.69	2.83	2.19	3.21
PSA_2107	☑	0.01	2.74	3.76	4.21	7.82	12.68	20.34	23.72	24.72
PSA_2108	☑	2.06	10.82	8.16	4.40	8.07	12.27	16.42	17.85	19.95
PSA_2109	☒	-	-	-	-	-	-	-	-	-
PSA_2110	☑	0.54	4.96	4.60	4.13	7.58	13.44	20.89	23.00	20.86
PSA_2111	☑	1.51	6.10	4.59	3.10	6.98	12.43	18.79	21.48	25.02
PSA_2112	☑	0.09	2.90	3.62	3.79	7.42	12.97	21.32	28.24	19.67
PSA_2113	☑	0.00	4.68	8.70	1.71	6.61	12.99	21.01	23.09	21.21
PS_2113_a	☑	0.07	5.03	5.95	1.34	7.87	15.75	22.14	21.82	20.03
PSA_2114	☑	0.50	6.18	6.29	4.40	7.20	12.36	19.27	21.85	21.95

Percentages taken from the final laser data.

* Final laser data not in percentages

- no laser analysis

Table 3. Summary of the particle size information received from participating laboratories and replicate analysis laboratory for the fifty-fifth particle size distribution - PS55.

Benchmark Data

Sample	% Gravel	% Sand	% Silt/Clay	Sediment Description (Post analysis)	Summary Data APEM verification							
					% Gravel		% Sand		% Silt/Clay		Sediment Description (Post analysis)	
REPLICATE 1	80.2	3.7	16.1	Gravel	☑	80.2	☑	3.7	☑	16.1	☑	Gravel
REPLICATE 2	79.6	3.7	16.7	Muddy Gravel	☑	79.6	☑	3.7	☑	16.7	☑	Muddy Gravel
REPLICATE 3	80.0	3.7	16.3	Muddy Gravel	☑	80.0	☑	3.7	☑	16.3	☑	Muddy Gravel
REPLICATE 4	80.0	3.9	16.1	Muddy Gravel	☑	80.0	☑	3.9	☑	16.1	☑	Muddy Gravel
REPLICATE 5	80.2	3.7	16.1	Gravel	☑	80.2	☑	3.7	☑	16.1	☑	Gravel
REP AVERAGE	80.0	3.7	16.3	Gravel	☑	80.0	☑	3.7	☑	16.3	☑	Gravel

Participant Data

Lab	% Gravel	% Sand	% Silt/Clay	Sediment Description (Post analysis)	Summary Data APEM verification							
					% Gravel		% Sand		% Silt/Clay		Sediment Description (Post analysis)	
PSA_2101	79.6	5.2	15.2	Sandy, muddy gravel	☑	79.6	☑	5.2	☑	15.2	☑	Muddy Gravel
PSA_2102	79.8	3.0	17.2	Muddy gravel	☑	79.8	☑	3.0	☑	17.2	☑	Muddy Gravel
PSA_2103	79.9	9.8	10.3	Muddy gravel	☑	79.9	☑	9.8	☑	10.3	☑	Muddy Gravel
PSA_2105	80.2	3.7	16.1	Gravel	☑	80.2	☑	3.7	☑	16.1	☑	Gravel
PSA_2106	81.3	5.4	13.3	Muddy gravel	☑	81.3	☒	5.8	☒	12.9	☒	Gravel
PSA_2107	81.5	2.0	16.5	Gravel	☑	81.5	☑	2.0	☑	16.5	☑	Gravel
PSA_2108	80.1	5.1	14.8	Gravel	☑	80.1	☑	5.1	☑	14.8	☑	Gravel
PSA_2109	78.5	5.5	16.0	Muddy gravel	☑	78.5	☑	5.5	☑	16.0	☑	Muddy Gravel
PSA_2110	-	-	-	-	☒	**80.5**	☒	**2.8**	☒	**16.7**	☒	**Gravel**
PSA_2111	61.4	5.9	32.7	Muddy gravel	☑	61.4	☑	5.9	☑	32.7	☑	Muddy Gravel
PSA_2112	80.3	2.1	17.6	Gravel	☑	80.3	☑	2.1	☑	17.6	☑	Gravel
PSA_2113	80.1	3.0	16.9	Gravel (with fine silt)	☑	80.1	☑	3.0	☑	16.9	☑	Gravel
PSA_2113_a	80.5	2.5	17.1	Gravel (with fine silt)	☑	80.5	☑	2.5	☑	17.1	☑	Gravel
PSA_2114	79.90	3.90	16.20	Muddy gravel	☑	79.9	☒	3.5	☒	16.6	☑	Muddy Gravel

- -Data not provided

☑ - Participant calculations of % Gravel, % Sand and % Silt/Clay are correct based on the final data submitted

☒ - Participant calculation different from APEM calculation using GRADISTAT on final merged data

Figure 1. Particle size distribution curves resulting from analysis of 5 replicate samples of sediment distributed as PS55 (Benchmark Data).

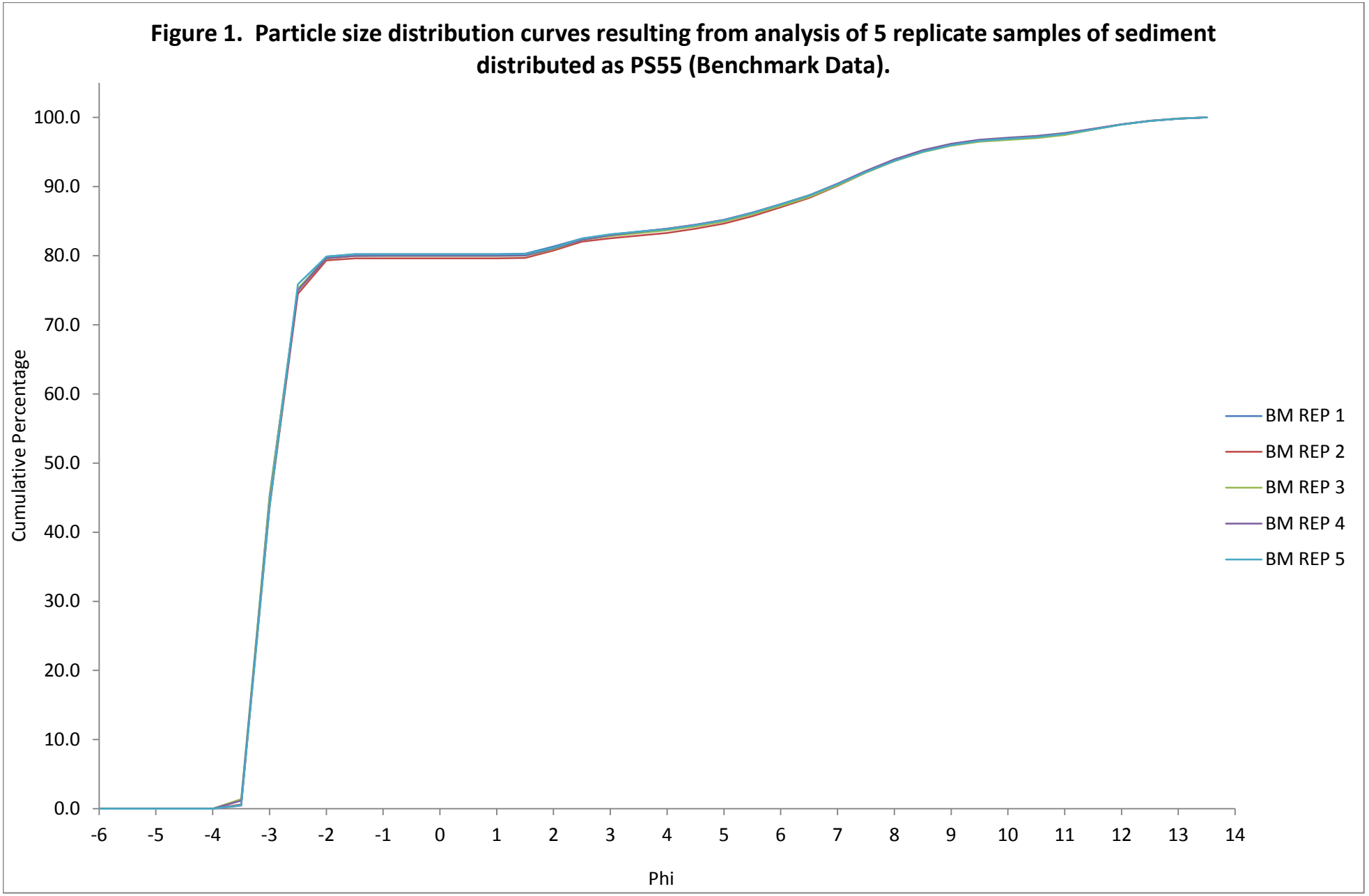


Figure 2. Particle size distribution curves from all participating laboratories for sediment distributed as PS55.

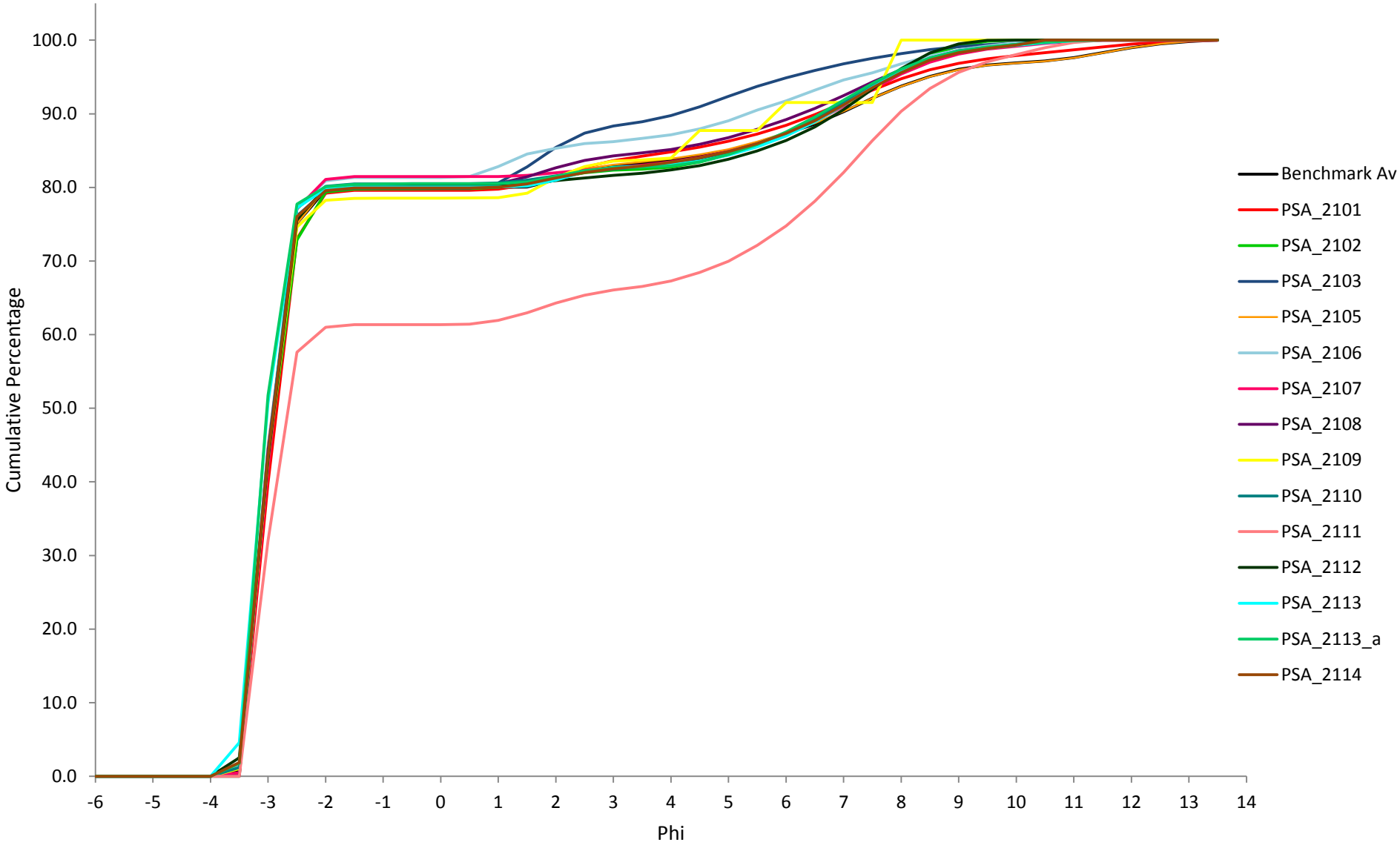
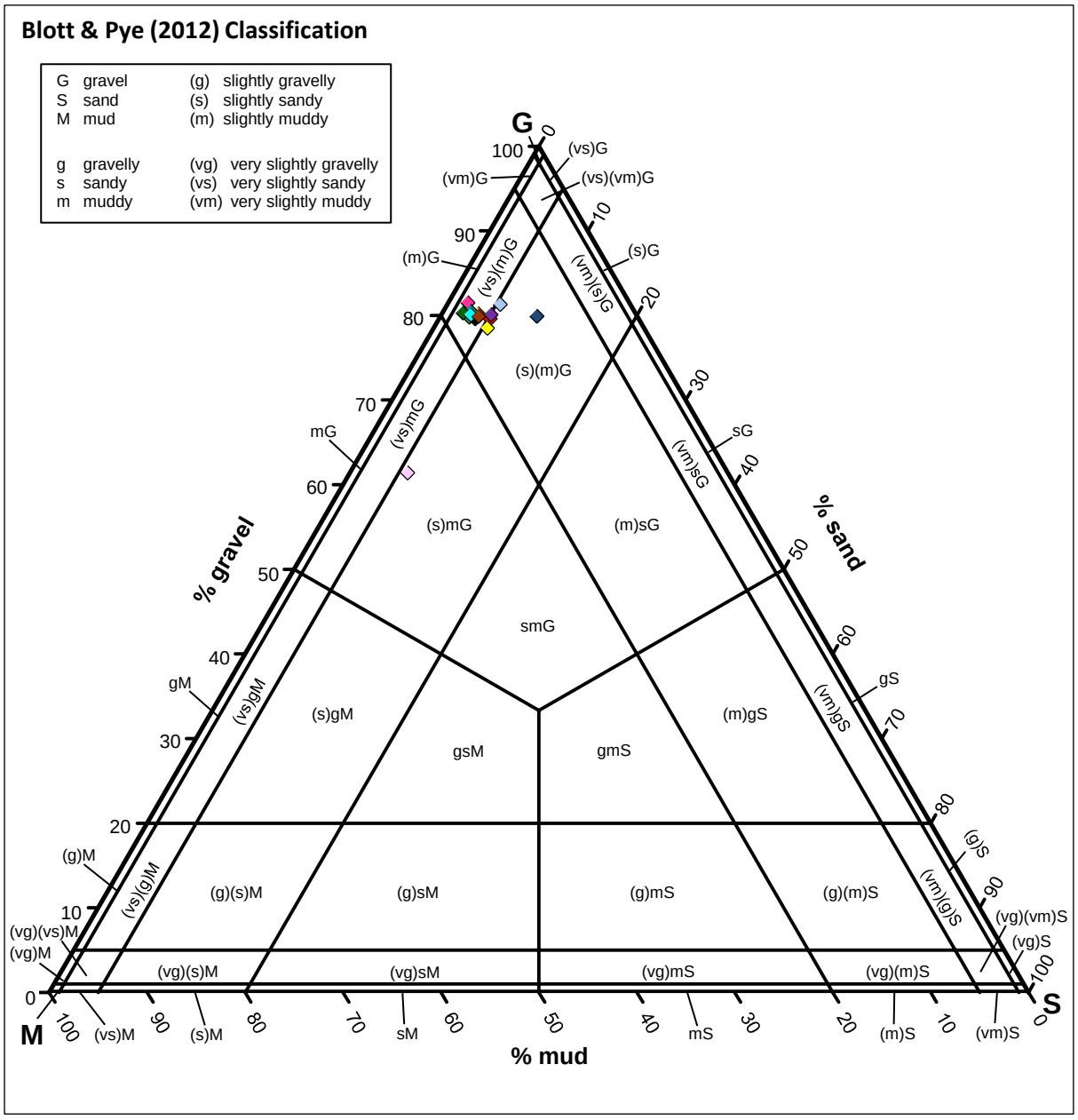


Figure 3. Particle size ternary diagram for PS55, including the Benchmark replicates an all participating laboratories for Gravel, Sand and Mud.



Laboratory

- Benchmark Average
- PSA_2101
- PSA_2102
- PSA_2103
- PSA_2105
- PSA_2106
- PSA_2107
- PSA_2108
- PSA_2109
- PSA_2110
- PSA_2111
- PSA_2112
- PSA_2113
- PSA_2113_a
- PSA_2114

Figure 4. Bar chart for PS55 showing the percentage gravel, sand, silt and mud recorded by each participating laboratory and the benchmark average.

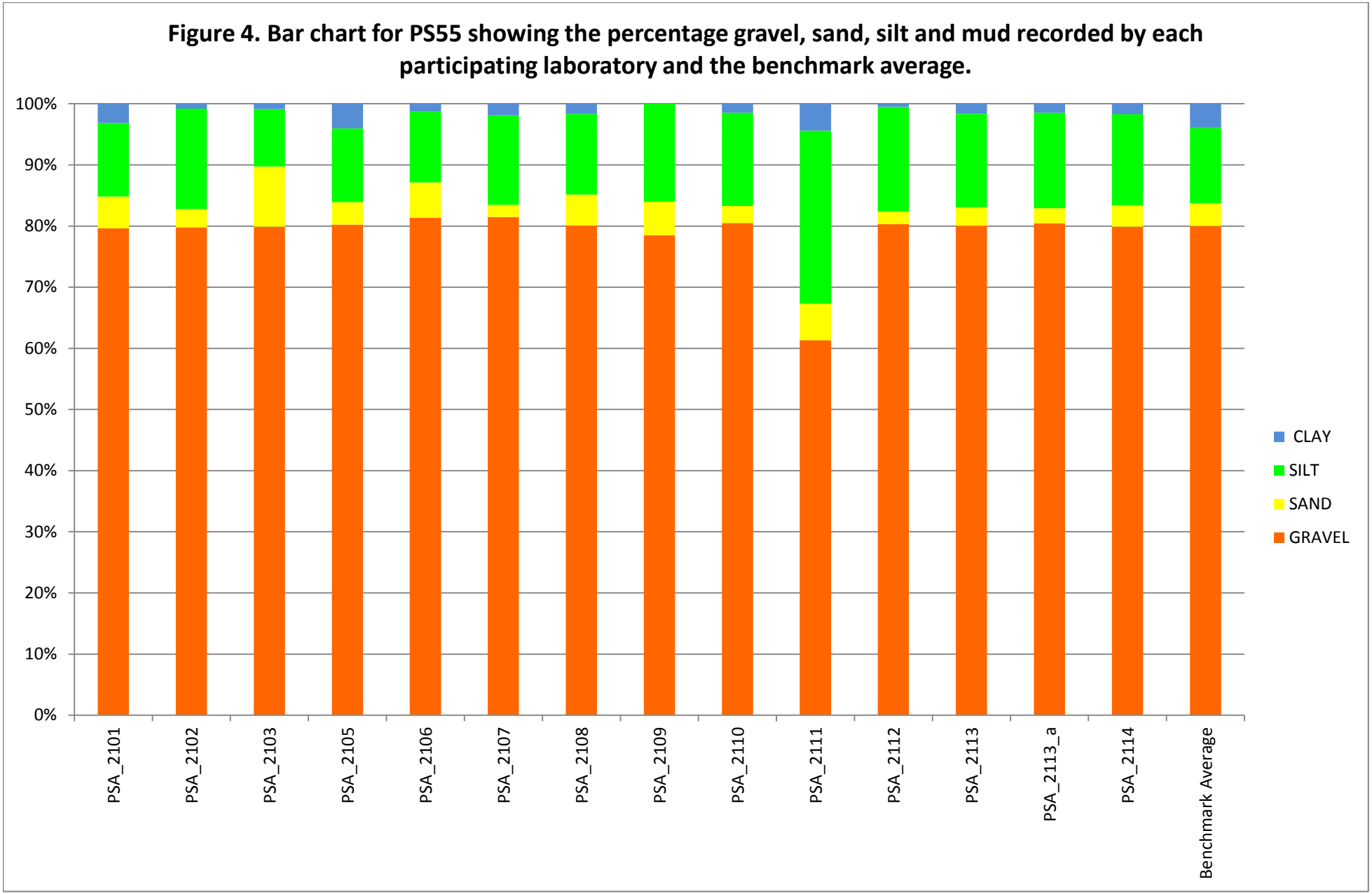


Table 4. Summary of z-scores for each phi-interval for PS55; data from all participating laboratories included in mean and standard deviation calculations.

	Phi-interval																		
	-6.50 to -6.00	-6.00 to -5.50	-5.50 to -5.00	-5.00 to -4.50	-4.50 to -4.00	-4.00 to -3.50	-3.50 to -3.00	-3.00 to -2.50	-2.50 to -2.00	-2.00 to -1.50	-1.50 to -1.00	-1.00 to -0.50	-0.50 to 0.00	0.00 to 0.50	0.50 to 1.00	1.00 to 1.50	1.50 to 2.00	2.00 to 2.50	2.50 to 3.00	3.00 to 3.50
Benchmark Average	0.00	0.00	0.00	0.00	0.00	-0.23	0.26	-0.05	0.45	0.02	-0.45	-0.52	-0.53	-0.53	-0.63	-0.90	-0.09	0.73	0.13	0.43
PSA_2101	0.00	0.00	0.00	0.00	0.00	-0.73	-0.74	0.75	1.88	1.00	-0.54	-0.38	-0.03	-0.28	-0.24	-0.04	0.02	0.82	1.59	1.60
PSA_2102	0.00	0.00	0.00	0.00	0.00	-0.91	0.13	-0.37	2.15	1.08	0.91	2.20	1.30	0.21	-0.16	-0.21	-0.43	-0.58	-0.96	-1.38
PSA_2103	0.00	0.00	0.00	0.00	0.00	-0.56	0.16	0.56	-0.48	-0.28	-0.55	-0.52	-0.29	-0.53	1.22	2.52	2.57	2.21	1.97	1.45
PSA_2105	0.00	0.00	0.00	0.00	0.00	-0.54	0.62	-0.40	0.70	0.16	-0.54	-0.52	-0.53	-0.53	-0.63	-0.89	-0.02	0.49	0.07	0.40
PSA_2106	0.00	0.00	0.00	0.00	0.00	0.17	0.15	0.61	-0.18	1.59	0.06	-0.52	-0.46	3.07	2.98	1.75	-0.45	-0.74	-1.28	0.62
PSA_2107	0.00	0.00	0.00	0.00	0.00	-0.52	-0.30	1.48	0.00	0.33	0.06	-0.52	-0.53	-0.53	-0.62	-0.71	-1.13	-1.36	-1.06	-0.13
PSA_2108	0.00	0.00	0.00	0.00	0.00	-0.91	0.46	0.19	0.07	-1.91	-0.55	-0.41	-0.29	0.05	0.41	0.52	0.28	0.09	0.31	0.33
PSA_2109	0.00	0.00	0.00	0.00	0.00	-0.07	-0.13	0.22	-0.31	-1.52	0.28	-0.52	-0.53	0.35	-0.55	0.00	1.80	1.18	0.84	-1.28
PSA_2110	0.00	0.00	0.00	0.00	0.00	0.08	-0.05	0.92	-0.86	-0.19	-0.61	0.85	-0.53	-0.53	-0.34	-0.36	-0.74	-1.05	-0.79	-0.02
PSA_2111	0.00	0.00	0.00	0.00	0.00	-0.91	-2.73	-1.83	-0.54	0.18	-0.61	-0.52	-0.53	1.35	0.74	0.67	0.46	0.17	0.82	0.81
PSA_2112	0.00	0.00	0.00	0.00	0.00	1.15	-0.52	0.59	0.20	0.90	-0.27	-0.38	-0.28	-0.53	-0.59	-0.68	-1.06	-1.36	-0.98	-0.34
PSA_2113	0.00	0.00	0.00	0.00	0.00	2.83	0.97	-1.53	-1.23	-1.49	-0.48	-0.11	0.67	-0.53	-0.63	-0.82	-0.33	0.33	0.32	-1.18
PSA_2113_a	0.00	0.00	0.00	0.00	0.00	0.52	1.97	-1.72	-1.43	-0.04	3.26	2.41	3.08	-0.53	-0.59	-0.62	-0.46	-0.41	-0.83	-1.64
PSA_2114	0.00	0.00	0.00	0.00	0.00	0.62	-0.24	0.56	-0.41	0.16	0.04	-0.52	-0.53	-0.53	-0.36	-0.25	-0.42	-0.52	-0.14	0.35
$\bar{x}$	0.00	0.00	0.00	0.00	0.00	1.11	42.45	30.99	4.01	0.341	0.009	0.004	0.002	0.020	0.236	0.615	1.037	0.968	0.551	0.35
s	0.00	0.00	0.00	0.00	0.00	1.22	3.83	2.92	1.16	0.058	0.015	0.007	0.004	0.037	0.375	0.629	0.617	0.437	0.217	0.16

z<-1.96 or z >1.96

All laboratories recorded zero therefore mean and standard deviation equal zero.

Table 4. Summary of z-scores for each phi-interval for PS55; data from all participating laboratories included in mean and standard deviation calculations.

	Phi-interval																			
	3.50 to 4.00	4.00 to 4.50	4.50 to 5.00	5.00 to 5.50	5.50 to 6.00	6.00 to 6.50	6.50 to 7.00	7.00 to 7.50	7.50 to 8.00	8.00 to 8.50	8.50 to 9.00	9.00 to 9.50	9.50 to 10.00	10.00 to 10.50	10.50 to 11.00	11.00 to 11.50	11.50 to 12.00	12.00 to 12.50	12.50 to 13.00	13.00 to 13.50
Benchmark Average	-0.20	-0.40	-0.51	-0.23	-0.55	-0.45	-0.26	-0.17	-0.42	-0.22	-0.05	0.08	-0.25	-0.31	1.06	2.12	2.27	2.29	2.29	2.13
PSA_2101	0.89	-0.33	-0.28	-0.42	-0.57	-0.28	-0.31	-0.31	-0.48	-0.36	-0.21	0.15	0.42	0.21	0.80	1.00	0.95	0.92	0.95	1.49
PSA_2102	-0.75	-0.30	0.34	0.34	-0.03	0.41	0.36	0.37	-0.09	0.60	0.64	0.18	-0.84	-1.26	-1.00	-0.69	-0.46	-0.46	-0.46	-0.48
PSA_2103	2.12	0.38	1.50	0.44	-0.63	-0.88	-1.20	-1.27	-0.97	-1.34	-1.26	-0.99	-0.62	-0.52	-0.33	-0.50	-0.46	-0.46	-0.46	-0.48
PSA_2105	-0.17	-0.41	-0.54	-0.25	-0.57	-0.49	-0.33	-0.23	-0.44	-0.24	-0.05	0.11	-0.23	-0.29	1.10	2.17	2.32	2.32	2.30	2.12
PSA_2106	0.14	-0.11	0.64	0.68	-0.53	-0.22	-0.63	-1.04	-0.66	-0.58	-0.26	-0.27	0.52	-0.24	-0.69	-0.69	-0.46	-0.46	-0.46	-0.48
PSA_2107	0.03	-0.32	-0.25	-0.29	-0.42	0.13	0.20	0.30	-0.18	0.19	0.23	0.35	0.29	0.22	0.35	-0.16	-0.46	-0.46	-0.46	-0.48
PSA_2108	0.16	-0.27	0.08	-0.07	-0.42	-0.13	-0.18	-0.17	-0.39	-0.13	-0.10	0.01	0.21	0.06	0.20	-0.31	-0.46	-0.46	-0.46	-0.48
PSA_2109	-1.04	3.49	-2.61	-2.67	3.10	-2.34	-2.24	-2.04	3.30	-2.11	-2.14	-1.94	-1.55	-1.26	-1.00	-0.69	-0.46	-0.46	-0.46	-0.48
PSA_2110	0.11	-0.33	-0.15	-0.05	-0.18	0.30	0.42	0.37	-0.17	0.22	0.03	-0.21	0.14	0.95	-1.00	-0.69	-0.46	-0.46	-0.46	-0.48
PSA_2111	1.54	0.31	1.89	2.33	1.46	2.49	2.39	2.36	0.86	2.36	2.64	2.97	2.76	2.46	2.28	0.56	-0.46	-0.46	-0.46	-0.48
PSA_2112	0.03	-0.40	-0.03	-0.09	-0.25	0.32	0.54	0.79	0.20	0.99	0.50	-0.32	-1.41	-1.26	-1.00	-0.69	-0.46	-0.46	-0.46	-0.48
PSA_2113	-1.49	-0.53	-0.15	-0.06	-0.22	0.40	0.47	0.44	-0.14	0.21	0.03	-0.05	0.13	0.06	0.22	-0.33	-0.46	-0.46	-0.46	-0.48
PSA_2113_a	-1.53	-0.44	0.28	0.48	0.13	0.62	0.44	0.27	-0.24	0.04	-0.07	-0.13	-0.02	-0.12	0.03	-0.43	-0.46	-0.46	-0.46	-0.48
PSA_2114	0.17	-0.35	-0.21	-0.12	-0.32	0.12	0.33	0.32	-0.19	0.34	0.07	0.06	0.45	1.30	-1.00	-0.69	-0.46	-0.46	-0.46	-0.48

$\bar{x}$	0.440	0.907	0.891	1.154	1.616	1.620	1.893	1.997	2.427	1.464	0.979	0.572	0.349	0.325	0.217	0.164	0.118	0.086	0.055	0.030
s	0.179	0.815	0.342	0.432	0.703	0.692	0.846	0.977	1.831	0.693	0.456	0.295	0.225	0.258	0.216	0.240	0.255	0.187	0.118	0.063

z<-1.96 or z >1.96

All laboratories recorded zero therefore mean and standard deviation equal zero.

Figure 5. Summary of z-scores at each half phi-interval for the Benchmark Average for PS55.

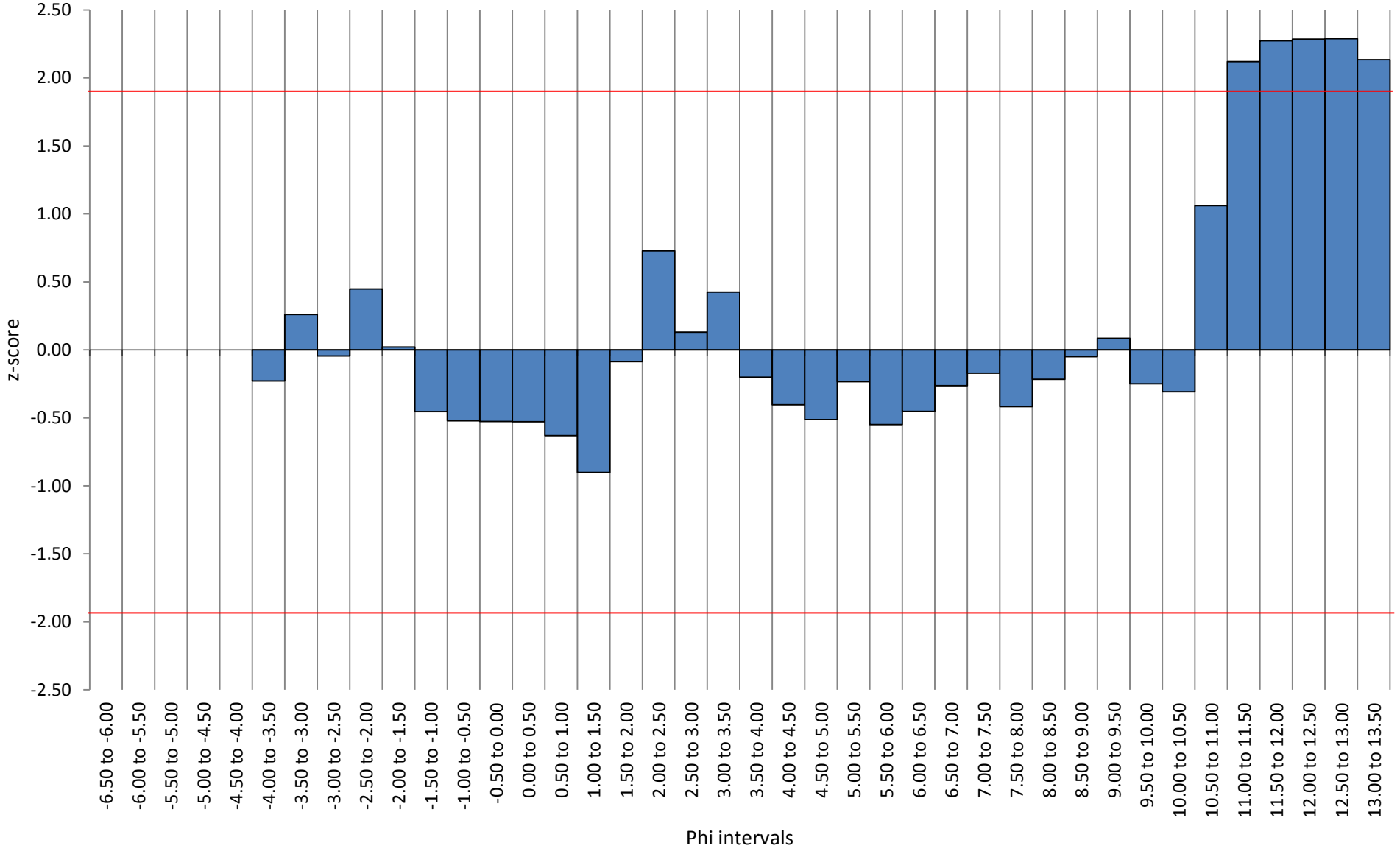
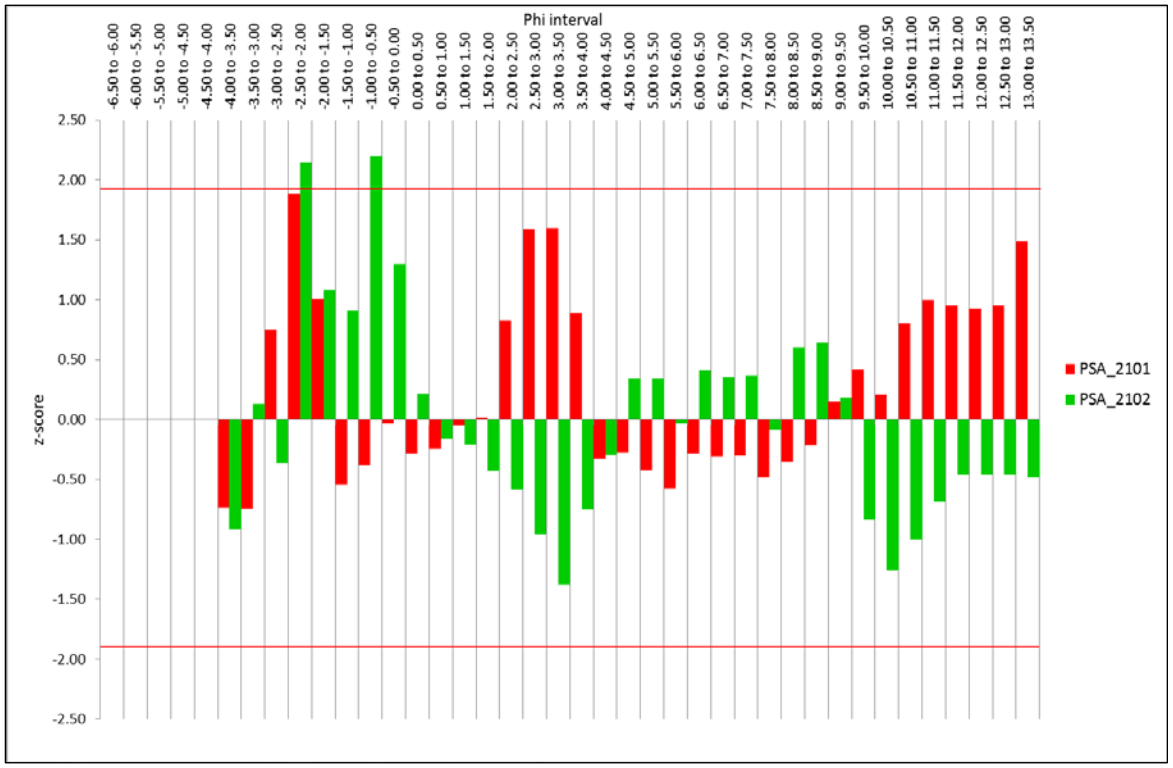


Figure 6. Summary of z-scores in each half phi-interval for PS55 for a) PSA_2101 and PSA_2102 and b) PSA_2103 and PSA_2105

a)



b)

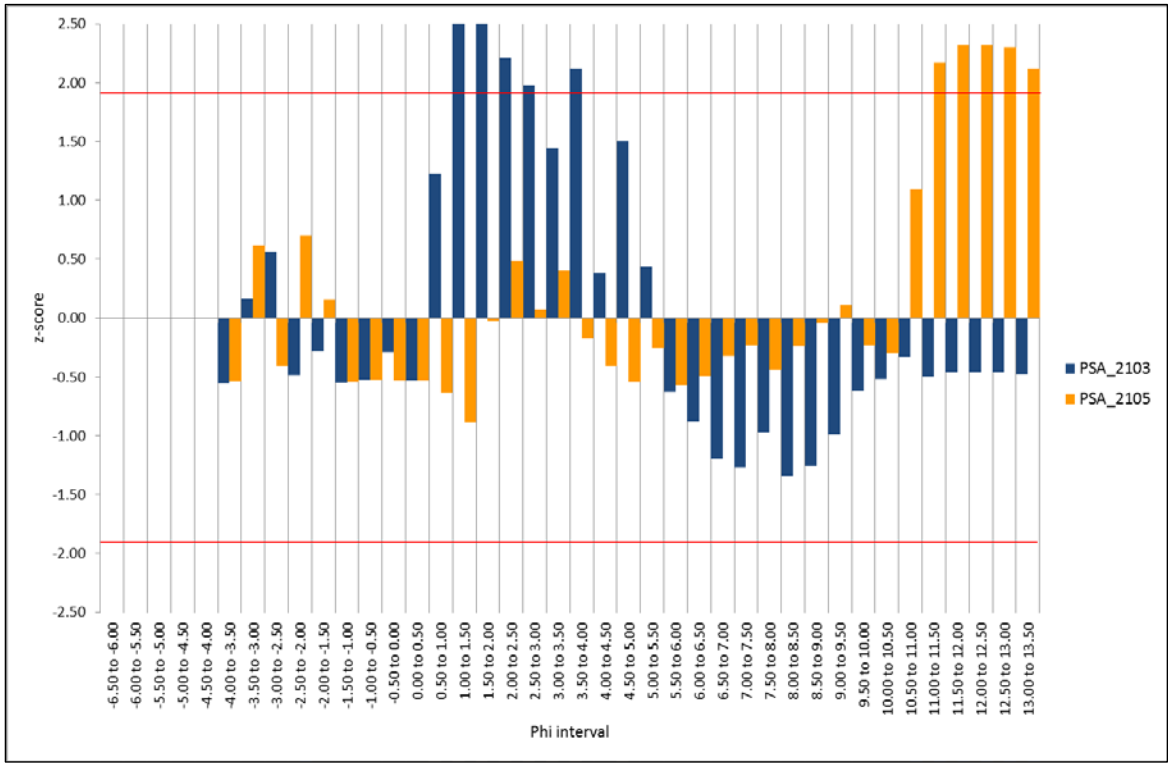
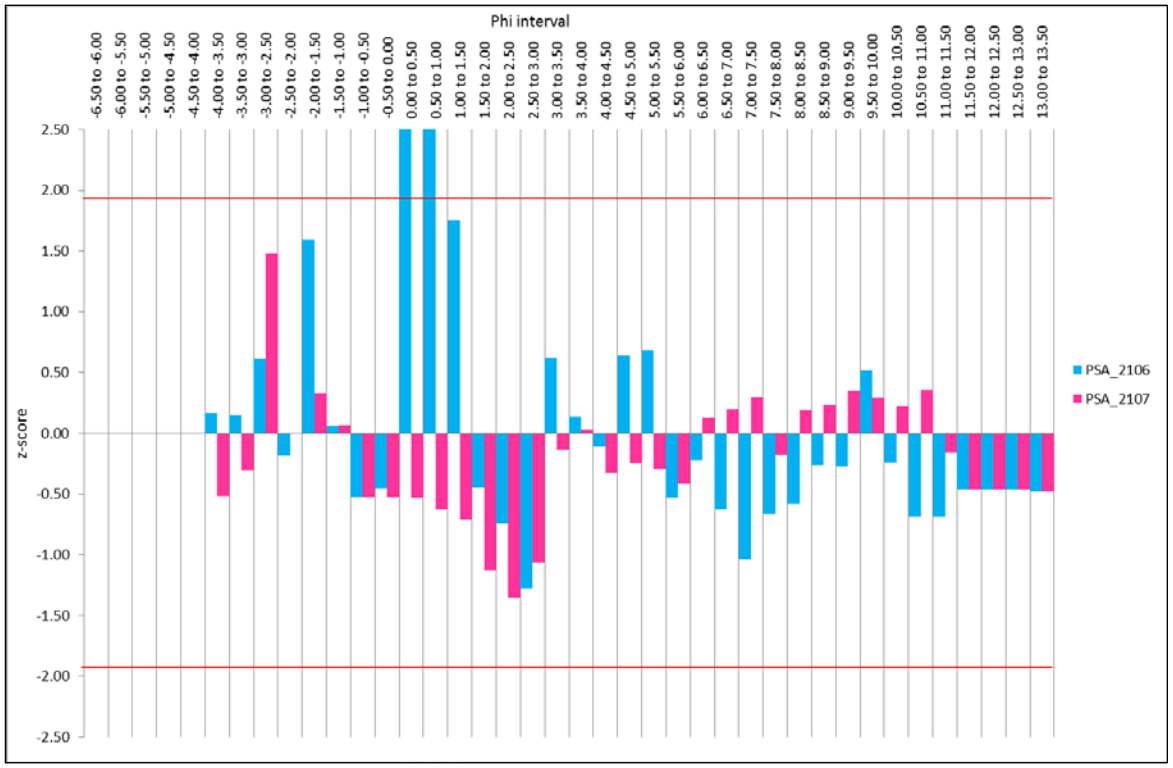


Figure 7. Summary of z-scores in each half phi-interval for PS55 for a) PSA_2106 and PSA_2107 and b) PSA_2108 and PSA_2109

a)



b)

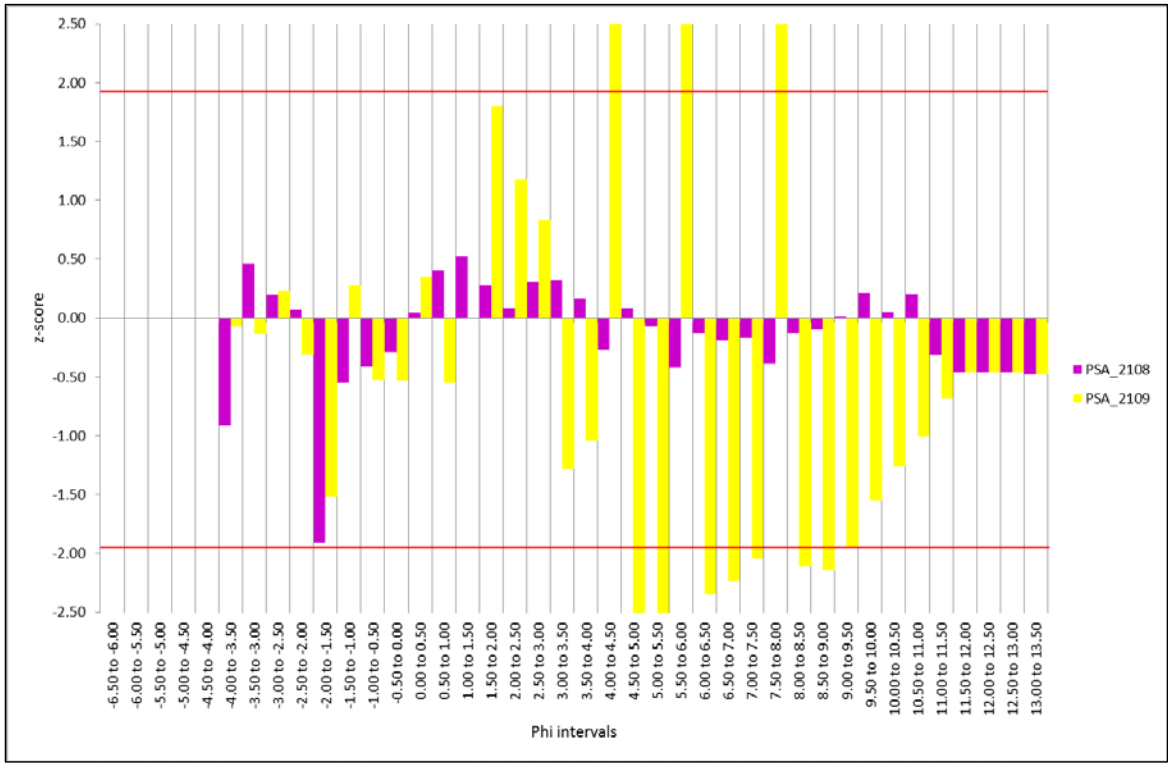
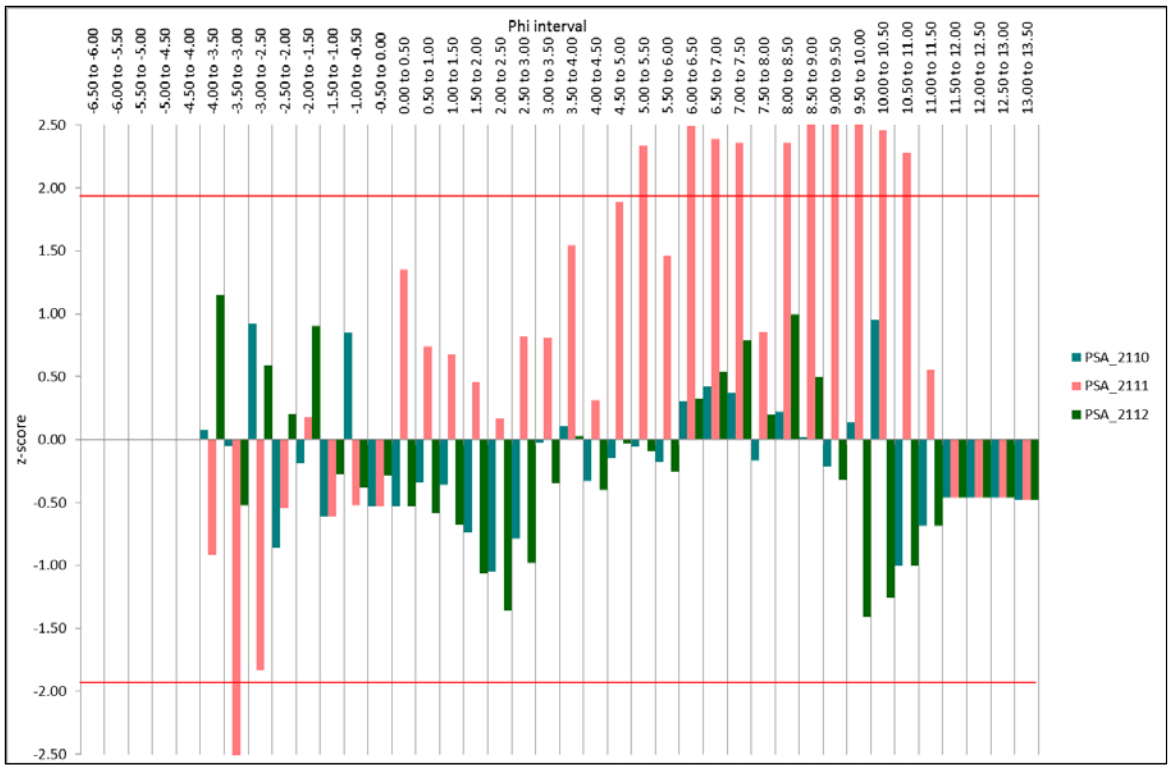


Figure 8. Summary of z-scores in each half phi-interval for PS55 for a) PSA_2110, PSA_2111 and PSA_2112 and b) PSA_2113, PSA_2113_a and PSA_2114

a)



b)

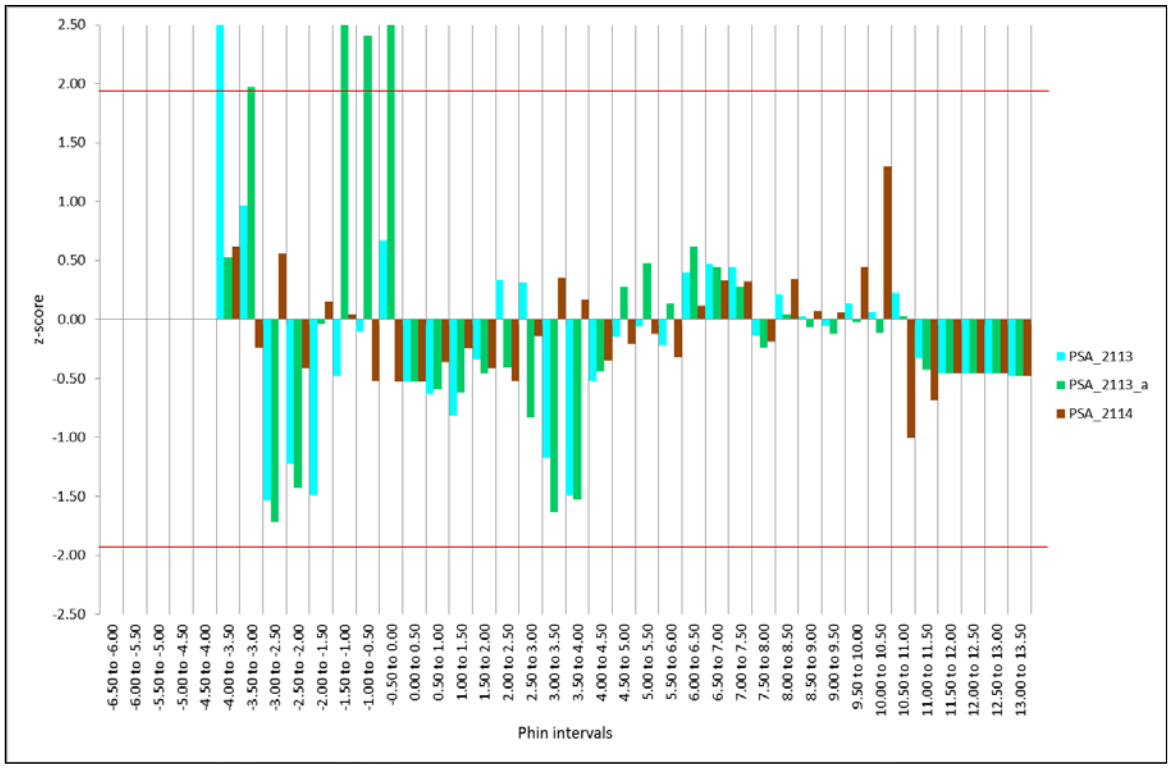
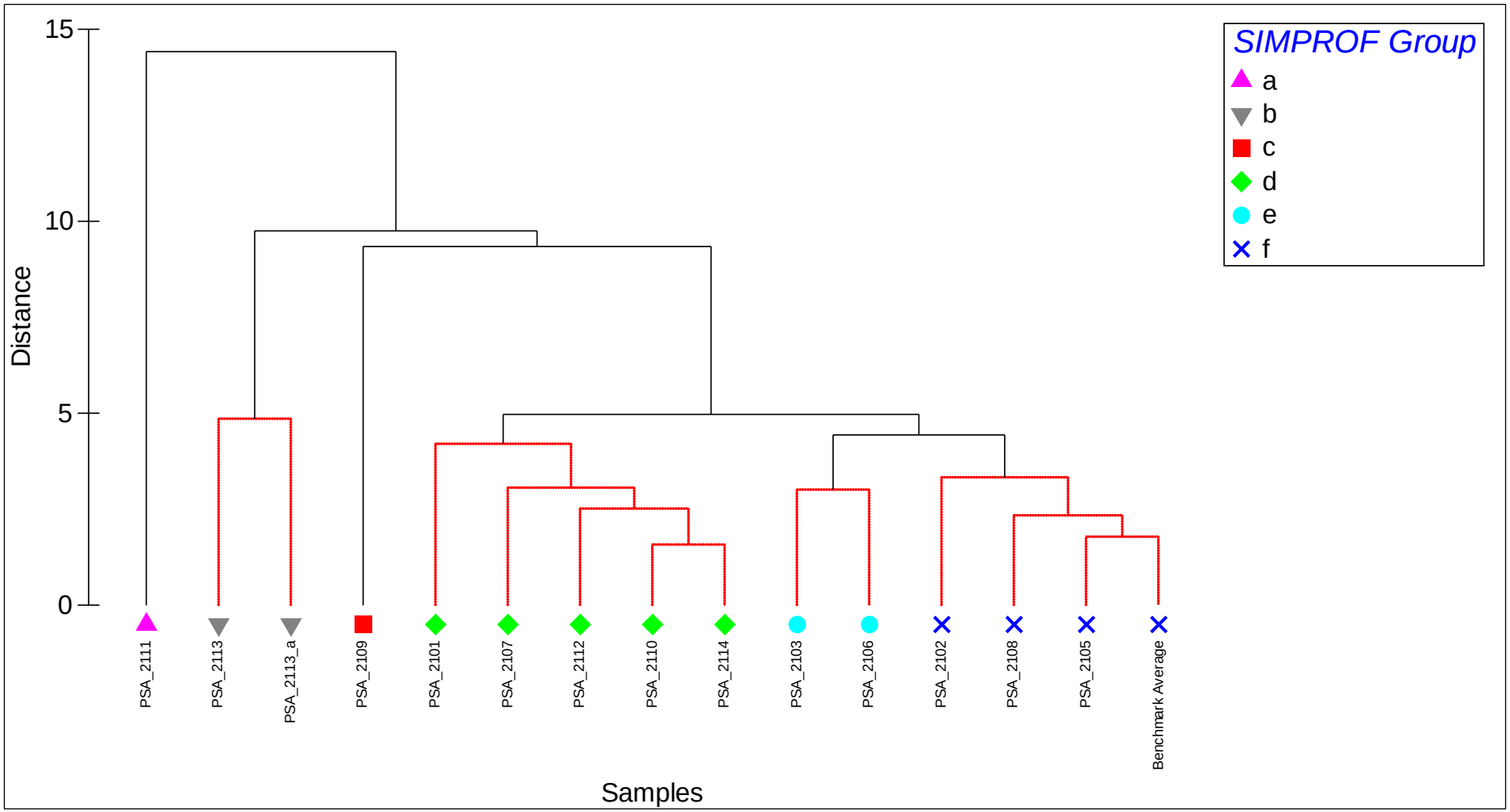


Figure 9. Cluster dendrogram of PS55 including all participating laboratories, with the benchmark replicates averaged.



Results of SIMPROF testing on PSA Ring test PS55 data

Data was entered into PRIMER v.6.1.13 in half-phi intervals; any missing data was entered as zero. The data did not need to be transformed as all data was on a similar percentage scale. A Euclidean distance matrix was created from the data. The Euclidian distance between two samples is (labs) j and k, is defined algebraically as;

$$d_{jk} = \sqrt{\sum_{i=1}^{p} (y_{ij} - y_{ik})^2}$$

From this distance matrix cluster analysis was carried out. The most commonly used clustering methods are hierarchical agglomerative methods. These use a similarity or distance matrix as there starting point and successively fuse the samples into groups and the groups into larger clusters, starting with the highest mutual similarities then gradually lowering the similarity level at which groups are formed. The result of a hierarchical clustering is represented by a dendrogram (Figure 10), with the X axis representing the full set of samples (labs) and the y axis defining the similarity at which two samples or groups are considered to have fused (Clarke &Warwick, 2001)[1].

A similarity profile routine, SIMPROF was run on the data in conjunction with the cluster analysis. Similarity profile analysis examines whether the similarities observed in the data are smaller and/or larger than those expected by chance. The red SIMPROF lines on the dendrogram (Figure 10) indicate that labs cannot be distinguished from each other at the 5% significance level; black lines indicate labs that can be distinguished from each other.

The cluster analysis separates the labs into 6 SIMPROF cluster groups, 2 of these groups compromise a single lab.

Cluster group A consists of one lab, PSA_2111, Figure 4 and Table 3 show that this laboratory recorded a higher percentage of mud (32.7%) and a lower percentage of gravel (61.4%) compared to other laboratories. This can also be seen on the cumulative percentage graph in Figure 2. This could be due to the large amount of sediment less than 1mm recorded (503.8g), approximately 200g more than other labs.

Cluster group C consists of one laboratory, PSA_2109. This laboratory used alternate methods and did not provide data in half phi intervals; this can be seen in the cumulative percentage graph in Figure 2. Despite this the percentage gravel, sand and mud recorded was similar to the majority of other laboratories.

The particle size ternary diagram in Figure 3 shows that the laboratories fell into 3 sediment classifications; Slightly sandy muddy Gravel (PSA_2111), very slightly sandy slightly muddy Gravel (Benchmark, PSA_2102, PSA_2105,PSA_2107, PSA_2110, PSA_2112, PSA_2113, PSA_2113_a and PSA_2114) and Slightly sandy slightly muddy Gravel (PSA_2101, PSA_2103,PSA_22106, PSA_2108 and PSA_2109).

[1] Clarke, K.R. & Warwick,R.M. (2001). Changes in Marine Communities; an approach to statistical analysis and interpretation. 2nd Ed. PRIMER-E Ltd. Plymouth.

Appendices

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Exercise Code:	**PS55**
LabCode:	**PSA_2101**
Sample Code:	**PS552101**

Phi interval (explicit) + sieve mesh (theoretical sieves shown in brackets)	Volume/Weight (mark as "0" for not analysed or no material)
-6.50 to -6.00; 63 mm	**0.00**
-6.00 to -5.50; 45 mm	**0.00**
-5.50 to -5.00; 31.5 mm	**0.00**
-5.00 to -4.50; 22.4 mm	**0.00**
-4.50 to -4.00; 16 mm	**0.00**
-4.00 to -3.50; 11.2 mm	**0.22**
-3.50 to -3.00; 8 mm	**39.62**
-3.00 to -2.50; 5.6 mm	**33.18**
-2.50 to -2.00; 4 mm	**6.19**
-2.00 to -1.50; 2.8 mm	**0.40**
-1.50 to -1.00; 2 mm	**0.00**
-1.00 to -0.50; 1.4 mm	**0.00**
-0.50 to 0.00; 1 mm	**0.00**
0.00 to 0.50; (707 µm)	0.01
0.50 to 1.00; (500 µm)	0.15
1.00 to 1.50; (353.6 µm)	0.59
1.50 to 2.00; (250 µm)	1.05
2.00 to 2.50; (176.8 µm)	1.33
2.50 to 3.00; (125 µm)	0.90
3.00 to 3.50; (88.39 µm)	0.61
3.50 to 4.00; (62.5 µm)	0.60
4.00 to 4.50; (44.19 µm)	0.64
4.50 to 5.00; (31.25 µm)	0.80
5.00 to 5.50; (22.097 µm)	0.97
5.50 to 6.00; (15.625 µm)	1.21
6.00 to 6.50; (11.049 µm)	1.43
6.50 to 7.00; (7.813 µm)	1.63
7.00 to 7.50; (5.524 µm)	1.70
7.50 to 8.00; (3.906 µm)	1.54
8.00 to 8.50; (2.762 µm)	1.22
8.50 to 9.00; (1.953 µm)	0.88
9.00 to 9.50; (1.381 µm)	0.62
9.50 to 10.00; (0.977 µm)	0.44
10.00 to 10.50; (0.691 µm)	0.38
10.50 to 11.00; (0.488 µm)	0.39
11.00 to 11.50; (0.345 µm)	0.40
11.50 to 12.00; (0.244 µm)	0.36
12.00 to 12.50; (0.173 µm)	0.26
12.50 to 13.00; (0.122 µm)	0.17
13.00 to 13.50; (0.086 µm)	0.12

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Exercise Code:	**PS55**
LabCode:	**PSA_2102**
Sample Code:	**PS552102**

Phi interval (explicit) + sieve mesh (theoretical sieves shown in brackets)	Volume/Weight (mark as "0" for not analysed or no material)
-6.50 to -6.00; 63 mm	**0.0000**
-6.00 to -5.50; 45 mm	**0.0000**
-5.50 to -5.00; 31.5 mm	**0.0000**
-5.00 to -4.50; 22.4 mm	**0.0000**
-4.50 to -4.00; 16 mm	**0.0000**
-4.00 to -3.50; 11.2 mm	**0.0000**
-3.50 to -3.00; 8 mm	**42.9461**
-3.00 to -2.50; 5.6 mm	**29.9209**
-2.50 to -2.00; 4 mm	**6.4972**
-2.00 to -1.50; 2.8 mm	**0.4035**
-1.50 to -1.00; 2 mm	**0.0231**
-1.00 to -0.50; 1.4 mm	**0.0198**
-0.50 to 0.00; 1 mm	**0.0077**
0.00 to 0.50; (707 µm)	0.0277
0.50 to 1.00; (500 µm)	0.1759
1.00 to 1.50; (353.6 µm)	0.4855
1.50 to 2.00; (250 µm)	0.7703
2.00 to 2.50; (176.8 µm)	0.7139
2.50 to 3.00; (125 µm)	0.3429
3.00 to 3.50; (88.39 µm)	0.1351
3.50 to 4.00; (62.5 µm)	0.3066
4.00 to 4.50; (44.19 µm)	0.6661
4.50 to 5.00; (31.25 µm)	1.0072
5.00 to 5.50; (22.097 µm)	1.2999
5.50 to 6.00; (15.625 µm)	1.5914
6.00 to 6.50; (11.049 µm)	1.9031
6.50 to 7.00; (7.813 µm)	2.1940
7.00 to 7.50; (5.524 µm)	2.3565
7.50 to 8.00; (3.906 µm)	2.2681
8.00 to 8.50; (2.762 µm)	1.8805
8.50 to 9.00; (1.953 µm)	1.2708
9.00 to 9.50; (1.381 µm)	0.6264
9.50 to 10.00; (0.977 µm)	0.1599
10.00 to 10.50; (0.691 µm)	0.0000
10.50 to 11.00; (0.488 µm)	0.0000
11.00 to 11.50; (0.345 µm)	0.0000
11.50 to 12.00; (0.244 µm)	0.0000
12.00 to 12.50; (0.173 µm)	0.0000
12.50 to 13.00; (0.122 µm)	0.0000
13.00 to 13.50; (0.086 µm)	0.0000

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Exercise Code:	**PS55**
LabCode:	**PSA_2103**
Sample Code:	**PS552103**

Phi interval (explicit) + sieve mesh (theoretical sieves shown in brackets)	Volume/Weight (mark as "0" for not analysed or no material)
-6.50 to -6.00; 63 mm	**0.0000**
-6.00 to -5.50; 45 mm	**0.0000**
-5.50 to -5.00; 31.5 mm	**0.0000**
-5.00 to -4.50; 22.4 mm	**0.0000**
-4.50 to -4.00; 16 mm	**0.0000**
-4.00 to -3.50; 11.2 mm	**4.3100**
-3.50 to -3.00; 8 mm	**428.5400**
-3.00 to -2.50; 5.6 mm	**324.8000**
-2.50 to -2.00; 4 mm	**34.3100**
-2.00 to -1.50; 2.8 mm	**3.2300**
-1.50 to -1.00; 2 mm	**0.0100**
-1.00 to -0.50; 1.4 mm	**0.0000**
-0.50 to 0.00; 1 mm	**0.0100**
0.00 to 0.50; (707 µm)	0.0000
0.50 to 1.00; (500 µm)	6.9172
1.00 to 1.50; (353.6 µm)	21.8979
1.50 to 2.00; (250 µm)	26.1362
2.00 to 2.50; (176.8 µm)	19.2590
2.50 to 3.00; (125 µm)	9.7494
3.00 to 3.50; (88.39 µm)	5.8043
3.50 to 4.00; (62.5 µm)	8.1434
4.00 to 4.50; (44.19 µm)	12.1351
4.50 to 5.00; (31.25 µm)	13.9677
5.00 to 5.50; (22.097 µm)	13.3547
5.50 to 6.00; (15.625 µm)	11.6953
6.00 to 6.50; (11.049 µm)	10.0760
6.50 to 7.00; (7.813 µm)	8.7298
7.00 to 7.50; (5.524 µm)	7.5703
7.50 to 8.00; (3.906 µm)	6.4441
8.00 to 8.50; (2.762 µm)	5.3379
8.50 to 9.00; (1.953 µm)	4.0317
9.00 to 9.50; (1.381 µm)	2.7989
9.50 to 10.00; (0.977 µm)	2.0858
10.00 to 10.50; (0.691 µm)	1.9059
10.50 to 11.00; (0.488 µm)	1.4594
11.00 to 11.50; (0.345 µm)	0.4465
11.50 to 12.00; (0.244 µm)	0.0000
12.00 to 12.50; (0.173 µm)	0.0000
12.50 to 13.00; (0.122 µm)	0.0000
13.00 to 13.50; (0.086 µm)	0.0000

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Exercise Code:	**PS55**
LabCode:	**PSA_2105**
Sample Code:	**PS552105**

Phi interval (explicit) + sieve mesh (theoretical sieves shown in brackets)	Volume/Weight (mark as "0" for not analysed or no material)
-6.50 to -6.00; 63 mm	**0.0000**
-6.00 to -5.50; 45 mm	**0.0000**
-5.50 to -5.00; 31.5 mm	**0.0000**
-5.00 to -4.50; 22.4 mm	**0.0000**
-4.50 to -4.00; 16 mm	**0.0000**
-4.00 to -3.50; 11.2 mm	**0.4590**
-3.50 to -3.00; 8 mm	**44.8010**
-3.00 to -2.50; 5.6 mm	**29.8093**
-2.50 to -2.00; 4 mm	**4.8226**
-2.00 to -1.50; 2.8 mm	**0.3501**
-1.50 to -1.00; 2 mm	**0.0011**
-1.00 to -0.50; 1.4 mm	**0.0000**
-0.50 to 0.00; 1 mm	**0.0000**
0.00 to 0.50; (707 µm)	0.0000
0.50 to 1.00; (500 µm)	0.0000
1.00 to 1.50; (353.6 µm)	0.0577
1.50 to 2.00; (250 µm)	1.0225
2.00 to 2.50; (176.8 µm)	1.1812
2.50 to 3.00; (125 µm)	0.5664
3.00 to 3.50; (88.39 µm)	0.4177
3.50 to 4.00; (62.5 µm)	0.4099
4.00 to 4.50; (44.19 µm)	0.5743
4.50 to 5.00; (31.25 µm)	0.7050
5.00 to 5.50; (22.097 µm)	1.0447
5.50 to 6.00; (15.625 µm)	1.2158
6.00 to 6.50; (11.049 µm)	1.2802
6.50 to 7.00; (7.813 µm)	1.6170
7.00 to 7.50; (5.524 µm)	1.7727
7.50 to 8.00; (3.906 µm)	1.6244
8.00 to 8.50; (2.762 µm)	1.3001
8.50 to 9.00; (1.953 µm)	0.9580
9.00 to 9.50; (1.381 µm)	0.6042
9.50 to 10.00; (0.977 µm)	0.2975
10.00 to 10.50; (0.691 µm)	0.2492
10.50 to 11.00; (0.488 µm)	0.4546
11.00 to 11.50; (0.345 µm)	0.6842
11.50 to 12.00; (0.244 µm)	0.7090
12.00 to 12.50; (0.173 µm)	0.5207
12.50 to 13.00; (0.122 µm)	0.3259
13.00 to 13.50; (0.086 µm)	0.1640

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Exercise Code:	**PS55**
LabCode:	**PSA_2106**
Sample Code:	**PS552106**

Phi interval (explicit) + sieve mesh (theoretical sieves shown in brackets)	Volume/Weight (mark as "0" for not analysed or no material)
-6.50 to -6.00; 63 mm	**0.0000**
-6.00 to -5.50; 45 mm	**0.0000**
-5.50 to -5.00; 31.5 mm	**0.0000**
-5.00 to -4.50; 22.4 mm	**0.0000**
-4.50 to -4.00; 16 mm	**0.0000**
-4.00 to -3.50; 11.2 mm	**1.3142**
-3.50 to -3.00; 8 mm	**43.0080**
-3.00 to -2.50; 5.6 mm	**32.7777**
-2.50 to -2.00; 4 mm	**3.7978**
-2.00 to -1.50; 2.8 mm	**0.4333**
-1.50 to -1.00; 2 mm	**0.0102**
-1.00 to -0.50; 1.4 mm	**0.0000**
-0.50 to 0.00; 1 mm	**0.0003**
0.00 to 0.50; (707 µm)	0.1343
0.50 to 1.00; (500 µm)	1.3528
1.00 to 1.50; (353.6 µm)	1.7186
1.50 to 2.00; (250 µm)	0.7595
2.00 to 2.50; (176.8 µm)	0.6438
2.50 to 3.00; (125 µm)	0.2743
3.00 to 3.50; (88.39 µm)	0.4516
3.50 to 4.00; (62.5 µm)	0.4646
4.00 to 4.50; (44.19 µm)	0.8173
4.50 to 5.00; (31.25 µm)	1.1084
5.00 to 5.50; (22.097 µm)	1.4480
5.50 to 6.00; (15.625 µm)	1.2428
6.00 to 6.50; (11.049 µm)	1.4667
6.50 to 7.00; (7.813 µm)	1.3622
7.00 to 7.50; (5.524 µm)	0.9796
7.50 to 8.00; (3.906 µm)	1.2148
8.00 to 8.50; (2.762 µm)	1.0636
8.50 to 9.00; (1.953 µm)	0.8584
9.00 to 9.50; (1.381 µm)	0.4926
9.50 to 10.00; (0.977 µm)	0.4665
10.00 to 10.50; (0.691 µm)	0.2631
10.50 to 11.00; (0.488 µm)	0.0685
11.00 to 11.50; (0.345 µm)	0.0000
11.50 to 12.00; (0.244 µm)	0.0000
12.00 to 12.50; (0.173 µm)	0.0000
12.50 to 13.00; (0.122 µm)	0.0000
13.00 to 13.50; (0.086 µm)	0.0000

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Exercise Code:	**PS55**
LabCode:	**PSA_2107**
Sample Code:	**PS552107**

Phi interval (explicit) + sieve mesh (theoretical sieves shown in brackets)	Volume/Weight (mark as "0" for not analysed or no material)
-6.50 to -6.00; 63 mm	**0.0000**
-6.00 to -5.50; 45 mm	**0.0000**
-5.50 to -5.00; 31.5 mm	**0.0000**
-5.00 to -4.50; 22.4 mm	**0.0000**
-4.50 to -4.00; 16 mm	**0.0000**
-4.00 to -3.50; 11.2 mm	**0.4837**
-3.50 to -3.00; 8 mm	**41.2824**
-3.00 to -2.50; 5.6 mm	**35.3232**
-2.50 to -2.00; 4 mm	**4.0140**
-2.00 to -1.50; 2.8 mm	**0.3602**
-1.50 to -1.00; 2 mm	**0.0103**
-1.00 to -0.50; 1.4 mm	**0.0000**
-0.50 to 0.00; 1 mm	**0.0000**
0.00 to 0.50; (707 µm)	0.0000
0.50 to 1.00; (500 µm)	0.0023
1.00 to 1.50; (353.6 µm)	0.1679
1.50 to 2.00; (250 µm)	0.3399
2.00 to 2.50; (176.8 µm)	0.3759
2.50 to 3.00; (125 µm)	0.3202
3.00 to 3.50; (88.39 µm)	0.3328
3.50 to 4.00; (62.5 µm)	0.4459
4.00 to 4.50; (44.19 µm)	0.6419
4.50 to 5.00; (31.25 µm)	0.8061
5.00 to 5.50; (22.097 µm)	1.0282
5.50 to 6.00; (15.625 µm)	1.3199
6.00 to 6.50; (11.049 µm)	1.7091
6.50 to 7.00; (7.813 µm)	2.0579
7.00 to 7.50; (5.524 µm)	2.2869
7.50 to 8.00; (3.906 µm)	2.1048
8.00 to 8.50; (2.762 µm)	1.5988
8.50 to 9.00; (1.953 µm)	1.0852
9.00 to 9.50; (1.381 µm)	0.6744
9.50 to 10.00; (0.977 µm)	0.4153
10.00 to 10.50; (0.691 µm)	0.3823
10.50 to 11.00; (0.488 µm)	0.2937
11.00 to 11.50; (0.345 µm)	0.1266
11.50 to 12.00; (0.244 µm)	0.0000
12.00 to 12.50; (0.173 µm)	0.0000
12.50 to 13.00; (0.122 µm)	0.0000
13.00 to 13.50; (0.086 µm)	0.0000

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Exercise Code:	**PS55**
LabCode:	**PSA_2108**
Sample Code:	**PS552108**

Phi interval (explicit) + sieve mesh (theoretical sieves shown in brackets)	Volume/Weight (mark as "0" for not analysed or no material)
-6.50 to -6.00; 63 mm	**0.0000**
-6.00 to -5.50; 45 mm	**0.0000**
-5.50 to -5.00; 31.5 mm	**0.0000**
-5.00 to -4.50; 22.4 mm	**0.0000**
-4.50 to -4.00; 16 mm	**0.0000**
-4.00 to -3.50; 11.2 mm	**0.0000**
-3.50 to -3.00; 8 mm	**44.2133**
-3.00 to -2.50; 5.6 mm	**31.5525**
-2.50 to -2.00; 4 mm	**4.0961**
-2.00 to -1.50; 2.8 mm	**0.2305**
-1.50 to -1.00; 2 mm	**0.0010**
-1.00 to -0.50; 1.4 mm	**0.0008**
-0.50 to 0.00; 1 mm	**0.0010**
0.00 to 0.50; (707 µm)	0.0215
0.50 to 1.00; (500 µm)	0.3882
1.00 to 1.50; (353.6 µm)	0.9451
1.50 to 2.00; (250 µm)	1.2082
2.00 to 2.50; (176.8 µm)	1.0068
2.50 to 3.00; (125 µm)	0.6175
3.00 to 3.50; (88.39 µm)	0.4055
3.50 to 4.00; (62.5 µm)	0.4699
4.00 to 4.50; (44.19 µm)	0.6866
4.50 to 5.00; (31.25 µm)	0.9197
5.00 to 5.50; (22.097 µm)	1.1238
5.50 to 6.00; (15.625 µm)	1.3189
6.00 to 6.50; (11.049 µm)	1.5312
6.50 to 7.00; (7.813 µm)	1.7368
7.00 to 7.50; (5.524 µm)	1.8353
7.50 to 8.00; (3.906 µm)	1.7179
8.00 to 8.50; (2.762 µm)	1.3743
8.50 to 9.00; (1.953 µm)	0.9350
9.00 to 9.50; (1.381 µm)	0.5766
9.50 to 10.00; (0.977 µm)	0.3969
10.00 to 10.50; (0.691 µm)	0.3393
10.50 to 11.00; (0.488 µm)	0.2604
11.00 to 11.50; (0.345 µm)	0.0892
11.50 to 12.00; (0.244 µm)	0.0000
12.00 to 12.50; (0.173 µm)	0.0000
12.50 to 13.00; (0.122 µm)	0.0000
13.00 to 13.50; (0.086 µm)	0.0000

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Exercise Code:	**PS55**
LabCode:	**PSA_2109**
Sample Code:	**PS552109**

Phi interval (explicit) + sieve mesh (theoretical sieves shown in brackets)	Volume/Weight (mark as "0" for not analysed or no material)
-6.50 to -6.00; 63 mm	**0.0000**
-6.00 to -5.50; 45 mm	**0.0000**
-5.50 to -5.00; 31.5 mm	**0.0000**
-5.00 to -4.50; 22.4 mm	**0.0000**
-4.50 to -4.00; 16 mm	**0.0000**
-4.00 to -3.50; 11.2 mm	**10.4190**
-3.50 to -3.00; 8 mm	**424.0460**
-3.00 to -2.50; 5.6 mm	**320.0310**
-2.50 to -2.00; 4 mm	**36.8830**
-2.00 to -1.50; 2.8 mm	**2.5610**
-1.50 to -1.00; 2 mm	**0.1370**
-1.00 to -0.50; 1.4 mm	**0.0000**
-0.50 to 0.00; 1 mm	**0.0000**
0.00 to 0.50; (707 µm)	0.3320
0.50 to 1.00; (500 µm)	0.3200
1.00 to 1.50; (353.6 µm)	6.1880
1.50 to 2.00; (250 µm)	21.7360
2.00 to 2.50; (176.8 µm)	15.0100
2.50 to 3.00; (125 µm)	7.4120
3.00 to 3.50; (88.39 µm)	1.5210
3.50 to 4.00; (62.5 µm)	2.5760
4.00 to 4.50; (44.19 µm)	37.9160
4.50 to 5.00; (31.25 µm)	0.0000
5.00 to 5.50; (22.097 µm)	0.0000
5.50 to 6.00; (15.625 µm)	38.4021
6.00 to 6.50; (11.049 µm)	0.0000
6.50 to 7.00; (7.813 µm)	0.0000
7.00 to 7.50; (5.524 µm)	0.0000
7.50 to 8.00; (3.906 µm)	85.7160
8.00 to 8.50; (2.762 µm)	0.0000
8.50 to 9.00; (1.953 µm)	0.0000
9.00 to 9.50; (1.381 µm)	0.0000
9.50 to 10.00; (0.977 µm)	0.0000
10.00 to 10.50; (0.691 µm)	0.0000
10.50 to 11.00; (0.488 µm)	0.0000
11.00 to 11.50; (0.345 µm)	0.0000
11.50 to 12.00; (0.244 µm)	0.0000
12.00 to 12.50; (0.173 µm)	0.0000
12.50 to 13.00; (0.122 µm)	0.0000
13.00 to 13.50; (0.086 µm)	0.0000

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Exercise Code:	**PS55**
LabCode:	**PSA_2110**
Sample Code:	**PS552110**

Phi interval (explicit) + sieve mesh (theoretical sieves shown in brackets)	Volume/Weight (mark as "0" for not analysed or no material)
-6.50 to -6.00; 63 mm	**0.0000**
-6.00 to -5.50; 45 mm	**0.0000**
-5.50 to -5.00; 31.5 mm	**0.0000**
-5.00 to -4.50; 22.4 mm	**0.0000**
-4.50 to -4.00; 16 mm	**0.0000**
-4.00 to -3.50; 11.2 mm	**1.2100**
-3.50 to -3.00; 8 mm	**42.2600**
-3.00 to -2.50; 5.6 mm	**33.6800**
-2.50 to -2.00; 4 mm	**3.0100**
-2.00 to -1.50; 2.8 mm	**0.3300**
-1.50 to -1.00; 2 mm	**0.0000**
-1.00 to -0.50; 1.4 mm	**0.0100**
-0.50 to 0.00; 1 mm	**0.0000**
0.00 to 0.50; (707 µm)	0.0000
0.50 to 1.00; (500 µm)	0.1100
1.00 to 1.50; (353.6 µm)	0.3900
1.50 to 2.00; (250 µm)	0.5800
2.00 to 2.50; (176.8 µm)	0.5100
2.50 to 3.00; (125 µm)	0.3800
3.00 to 3.50; (88.39 µm)	0.3500
3.50 to 4.00; (62.5 µm)	0.4600
4.00 to 4.50; (44.19 µm)	0.6400
4.50 to 5.00; (31.25 µm)	0.8400
5.00 to 5.50; (22.097 µm)	1.1300
5.50 to 6.00; (15.625 µm)	1.4900
6.00 to 6.50; (11.049 µm)	1.8300
6.50 to 7.00; (7.813 µm)	2.2500
7.00 to 7.50; (5.524 µm)	2.3600
7.50 to 8.00; (3.906 µm)	2.1200
8.00 to 8.50; (2.762 µm)	1.6200
8.50 to 9.00; (1.953 µm)	0.9900
9.00 to 9.50; (1.381 µm)	0.5100
9.50 to 10.00; (0.977 µm)	0.3800
10.00 to 10.50; (0.691 µm)	
10.50 to 11.00; (0.488 µm)	
11.00 to 11.50; (0.345 µm)	
11.50 to 12.00; (0.244 µm)	0.5700
12.00 to 12.50; (0.173 µm)	
12.50 to 13.00; (0.122 µm)	
13.00 to 13.50; (0.086 µm)	

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Exercise Code:	**PS55**
LabCode:	**PSA_2111**
Sample Code:	**PS552111**

Phi interval (explicit) + sieve mesh (theoretical sieves shown in brackets)	Volume/Weight (mark as "0" for not analysed or no material)
-6.50 to -6.00; 63 mm	**0.0000**
-6.00 to -5.50; 45 mm	**0.0000**
-5.50 to -5.00; 31.5 mm	**0.0000**
-5.00 to -4.50; 22.4 mm	**0.0000**
-4.50 to -4.00; 16 mm	**0.0000**
-4.00 to -3.50; 11.2 mm	**0.0000**
-3.50 to -3.00; 8 mm	**417.1000**
-3.00 to -2.50; 5.6 mm	**334.3667**
-2.50 to -2.00; 4 mm	**44.0667**
-2.00 to -1.50; 2.8 mm	**4.5833**
-1.50 to -1.00; 2 mm	**0.0000**
-1.00 to -0.50; 1.4 mm	**0.0000**
-0.50 to 0.00; 1 mm	**0.0000**
0.00 to 0.50; (707 µm)	0.9159
0.50 to 1.00; (500 µm)	6.7066
1.00 to 1.50; (353.6 µm)	13.5306
1.50 to 2.00; (250 µm)	17.2058
2.00 to 2.50; (176.8 µm)	13.5945
2.50 to 3.00; (125 µm)	9.5102
3.00 to 3.50; (88.39 µm)	6.2874
3.50 to 4.00; (62.5 µm)	9.3359
4.00 to 4.50; (44.19 µm)	15.1528
4.50 to 5.00; (31.25 µm)	20.0140
5.00 to 5.50; (22.097 µm)	28.1866
5.50 to 6.00; (15.625 µm)	34.4589
6.00 to 6.50; (11.049 µm)	43.6170
6.50 to 7.00; (7.813 µm)	51.0254
7.00 to 7.50; (5.524 µm)	56.1354
7.50 to 8.00; (3.906 µm)	52.0687
8.00 to 8.50; (2.762 µm)	40.4370
8.50 to 9.00; (1.953 µm)	28.4597
9.00 to 9.50; (1.381 µm)	18.8588
9.50 to 10.00; (0.977 µm)	12.6519
10.00 to 10.50; (0.691 µm)	12.5003
10.50 to 11.00; (0.488 µm)	9.2669
11.00 to 11.50; (0.345 µm)	3.8777
11.50 to 12.00; (0.244 µm)	0.0000
12.00 to 12.50; (0.173 µm)	0.0000
12.50 to 13.00; (0.122 µm)	0.0000
13.00 to 13.50; (0.086 µm)	0.0000

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Exercise Code:	**PS55**
LabCode:	**PSA_2112**
Sample Code:	**PS552112**

Phi interval (explicit) + sieve mesh (theoretical sieves shown in brackets)	Volume/Weight (mark as "0" for not analysed or no material)
-6.50 to -6.00; 63 mm	**0.0000**
-6.00 to -5.50; 45 mm	**0.0000**
-5.50 to -5.00; 31.5 mm	**0.0000**
-5.00 to -4.50; 22.4 mm	**0.0000**
-4.50 to -4.00; 16 mm	**0.0000**
-4.00 to -3.50; 11.2 mm	**24.4000**
-3.50 to -3.00; 8 mm	**391.8200**
-3.00 to -2.50; 5.6 mm	**317.0000**
-2.50 to -2.00; 4 mm	**41.1200**
-2.00 to -1.50; 2.8 mm	**3.8100**
-1.50 to -1.00; 2 mm	**0.0500**
-1.00 to -0.50; 1.4 mm	**0.0100**
-0.50 to 0.00; 1 mm	**0.0100**
0.00 to 0.50; (707 µm)	0.0000
0.50 to 1.00; (500 µm)	0.1649
1.00 to 1.50; (353.6 µm)	1.8280
1.50 to 2.00; (250 µm)	3.6923
2.00 to 2.50; (176.8 µm)	3.6127
2.50 to 3.00; (125 µm)	3.2761
3.00 to 3.50; (88.39 µm)	2.8992
3.50 to 4.00; (62.5 µm)	4.3188
4.00 to 4.50; (44.19 µm)	5.6081
4.50 to 5.00; (31.25 µm)	8.5231
5.00 to 5.50; (22.097 µm)	10.7807
5.50 to 6.00; (15.625 µm)	13.9298
6.00 to 6.50; (11.049 µm)	17.8600
6.50 to 7.00; (7.813 µm)	22.7650
7.00 to 7.50; (5.524 µm)	26.8226
7.50 to 8.00; (3.906 µm)	26.9813
8.00 to 8.50; (2.762 µm)	20.8503
8.50 to 9.00; (1.953 µm)	11.6842
9.00 to 9.50; (1.381 µm)	4.6314
9.50 to 10.00; (0.977 µm)	0.3095
10.00 to 10.50; (0.691 µm)	0.0000
10.50 to 11.00; (0.488 µm)	0.0010
11.00 to 11.50; (0.345 µm)	0.0008
11.50 to 12.00; (0.244 µm)	0.0000
12.00 to 12.50; (0.173 µm)	0.0000
12.50 to 13.00; (0.122 µm)	0.0000
13.00 to 13.50; (0.086 µm)	0.0000

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Exercise Code:	**PS55**
LabCode:	**PSA_2113**
Sample Code:	**PS552113**

Phi interval (explicit) + sieve mesh (theoretical sieves shown in brackets)	Volume/Weight (mark as "0" for not analysed or no material)
-6.50 to -6.00; 63 mm	**0.0000**
-6.00 to -5.50; 45 mm	**0.0000**
-5.50 to -5.00; 31.5 mm	**0.0000**
-5.00 to -4.50; 22.4 mm	**0.0000**
-4.50 to -4.00; 16 mm	**0.0000**
-4.00 to -3.50; 11.2 mm	**4.5688**
-3.50 to -3.00; 8 mm	**46.1408**
-3.00 to -2.50; 5.6 mm	**26.5081**
-2.50 to -2.00; 4 mm	**2.5856**
-2.00 to -1.50; 2.8 mm	**0.2547**
-1.50 to -1.00; 2 mm	**0.0020**
-1.00 to -0.50; 1.4 mm	**0.0030**
-0.50 to 0.00; 1 mm	**0.0051**
0.00 to 0.50; (707 µm)	0.0000
0.50 to 1.00; (500 µm)	0.0001
1.00 to 1.50; (353.6 µm)	0.1013
1.50 to 2.00; (250 µm)	0.8308
2.00 to 2.50; (176.8 µm)	1.1139
2.50 to 3.00; (125 µm)	0.6199
3.00 to 3.50; (88.39 µm)	0.1671
3.50 to 4.00; (62.5 µm)	0.1740
4.00 to 4.50; (44.19 µm)	0.4781
4.50 to 5.00; (31.25 µm)	0.8390
5.00 to 5.50; (22.097 µm)	1.1285
5.50 to 6.00; (15.625 µm)	1.4602
6.00 to 6.50; (11.049 µm)	1.8951
6.50 to 7.00; (7.813 µm)	2.2930
7.00 to 7.50; (5.524 µm)	2.4293
7.50 to 8.00; (3.906 µm)	2.1738
8.00 to 8.50; (2.762 µm)	1.6101
8.50 to 9.00; (1.953 µm)	0.9902
9.00 to 9.50; (1.381 µm)	0.5562
9.50 to 10.00; (0.977 µm)	0.3793
10.00 to 10.50; (0.691 µm)	0.3415
10.50 to 11.00; (0.488 µm)	0.2654
11.00 to 11.50; (0.345 µm)	0.0850
11.50 to 12.00; (0.244 µm)	0.0000
12.00 to 12.50; (0.173 µm)	0.0000
12.50 to 13.00; (0.122 µm)	0.0000
13.00 to 13.50; (0.086 µm)	0.0000

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Exercise Code:	**PS55**
LabCode:	**PSA_2113_a**
Sample Code:	**PS552113**

Phi interval (explicit) + sieve mesh (theoretical sieves shown in brackets)	Volume/Weight (mark as "0" for not analysed or no material)
-6.50 to -6.00; 63 mm	**0.0000**
-6.00 to -5.50; 45 mm	**0.0000**
-5.50 to -5.00; 31.5 mm	**0.0000**
-5.00 to -4.50; 22.4 mm	**0.0000**
-4.50 to -4.00; 16 mm	**0.0000**
-4.00 to -3.50; 11.2 mm	**1.7529**
-3.50 to -3.00; 8 mm	**49.9995**
-3.00 to -2.50; 5.6 mm	**25.9708**
-2.50 to -2.00; 4 mm	**2.3511**
-2.00 to -1.50; 2.8 mm	**0.3388**
-1.50 to -1.00; 2 mm	**0.0590**
-1.00 to -0.50; 1.4 mm	**0.0214**
-0.50 to 0.00; 1 mm	**0.0153**
0.00 to 0.50; (707 µm)	0.0000
0.50 to 1.00; (500 µm)	0.0136
1.00 to 1.50; (353.6 µm)	0.2239
1.50 to 2.00; (250 µm)	0.7557
2.00 to 2.50; (176.8 µm)	0.7901
2.50 to 3.00; (125 µm)	0.3702
3.00 to 3.50; (88.39 µm)	0.0940
3.50 to 4.00; (62.5 µm)	0.1678
4.00 to 4.50; (44.19 µm)	0.5468
4.50 to 5.00; (31.25 µm)	0.9863
5.00 to 5.50; (22.097 µm)	1.3593
5.50 to 6.00; (15.625 µm)	1.7098
6.00 to 6.50; (11.049 µm)	2.0468
6.50 to 7.00; (7.813 µm)	2.2689
7.00 to 7.50; (5.524 µm)	2.2653
7.50 to 8.00; (3.906 µm)	1.9882
8.00 to 8.50; (2.762 µm)	1.4951
8.50 to 9.00; (1.953 µm)	0.9480
9.00 to 9.50; (1.381 µm)	0.5352
9.50 to 10.00; (0.977 µm)	0.3453
10.00 to 10.50; (0.691 µm)	0.2951
10.50 to 11.00; (0.488 µm)	0.2235
11.00 to 11.50; (0.345 µm)	0.0624
11.50 to 12.00; (0.244 µm)	0.0000
12.00 to 12.50; (0.173 µm)	0.0000
12.50 to 13.00; (0.122 µm)	0.0000
13.00 to 13.50; (0.086 µm)	0.0000

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Exercise Code:	**PS55**
LabCode:	**PSA_2114**
Sample Code:	**PS552114**

Phi interval (explicit) + sieve mesh (theoretical sieves shown in brackets)	Volume/Weight (mark as "0" for not analysed or no material)
-6.50 to -6.00; 63 mm	**0.0000**
-6.00 to -5.50; 45 mm	**0.0000**
-5.50 to -5.00; 31.5 mm	**0.0000**
-5.00 to -4.50; 22.4 mm	**0.0000**
-4.50 to -4.00; 16 mm	**0.0000**
-4.00 to -3.50; 11.2 mm	**1.8700**
-3.50 to -3.00; 8 mm	**41.5400**
-3.00 to -2.50; 5.6 mm	**32.6300**
-2.50 to -2.00; 4 mm	**3.5300**
-2.00 to -1.50; 2.8 mm	**0.3500**
-1.50 to -1.00; 2 mm	**0.0100**
-1.00 to -0.50; 1.4 mm	**0.0000**
-0.50 to 0.00; 1 mm	**0.0000**
0.00 to 0.50; (707 µm)	0.0000
0.50 to 1.00; (500 µm)	0.1000
1.00 to 1.50; (353.6 µm)	0.4600
1.50 to 2.00; (250 µm)	0.7800
2.00 to 2.50; (176.8 µm)	0.7400
2.50 to 3.00; (125 µm)	0.5200
3.00 to 3.50; (88.39 µm)	0.4100
3.50 to 4.00; (62.5 µm)	0.4700
4.00 to 4.50; (44.19 µm)	0.6200
4.50 to 5.00; (31.25 µm)	0.8200
5.00 to 5.50; (22.097 µm)	1.1000
5.50 to 6.00; (15.625 µm)	1.3900
6.00 to 6.50; (11.049 µm)	1.7000
6.50 to 7.00; (7.813 µm)	2.1700
7.00 to 7.50; (5.524 µm)	2.3100
7.50 to 8.00; (3.906 µm)	2.0800
8.00 to 8.50; (2.762 µm)	1.7000
8.50 to 9.00; (1.953 µm)	1.0100
9.00 to 9.50; (1.381 µm)	0.5900
9.50 to 10.00; (0.977 µm)	0.4500
10.00 to 10.50; (0.691 µm)	0.6600
10.50 to 11.00; (0.488 µm)	0.0000
11.00 to 11.50; (0.345 µm)	0.0000
11.50 to 12.00; (0.244 µm)	0.0000
12.00 to 12.50; (0.173 µm)	0.0000
12.50 to 13.00; (0.122 µm)	0.0000
13.00 to 13.50; (0.086 µm)	0.0000

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Exercise Code:	**PS55**
LabCode:	**PSA_BENCHMARK REPLICATE 1**
Sample Code:	**PS5521BMREP1**

Phi interval (explicit) + sieve mesh (theoretical sieves shown in brackets)	Volume/Weight (mark as "0" for not analysed or no material)
-6.50 to -6.00; 63 mm	**0.0000**
-6.00 to -5.50; 45 mm	**0.0000**
-5.50 to -5.00; 31.5 mm	**0.0000**
-5.00 to -4.50; 22.4 mm	**0.0000**
-4.50 to -4.00; 16 mm	**0.0000**
-4.00 to -3.50; 11.2 mm	**0.4590**
-3.50 to -3.00; 8 mm	**44.8010**
-3.00 to -2.50; 5.6 mm	**29.8093**
-2.50 to -2.00; 4 mm	**4.8226**
-2.00 to -1.50; 2.8 mm	**0.3501**
-1.50 to -1.00; 2 mm	**0.0011**
-1.00 to -0.50; 1.4 mm	**0.0000**
-0.50 to 0.00; 1 mm	**0.0000**
0.00 to 0.50; (707 µm)	0.0000
0.50 to 1.00; (500 µm)	0.0000
1.00 to 1.50; (353.6 µm)	0.0577
1.50 to 2.00; (250 µm)	1.0225
2.00 to 2.50; (176.8 µm)	1.1812
2.50 to 3.00; (125 µm)	0.5664
3.00 to 3.50; (88.39 µm)	0.4177
3.50 to 4.00; (62.5 µm)	0.4099
4.00 to 4.50; (44.19 µm)	0.5743
4.50 to 5.00; (31.25 µm)	0.7050
5.00 to 5.50; (22.097 µm)	1.0447
5.50 to 6.00; (15.625 µm)	1.2158
6.00 to 6.50; (11.049 µm)	1.2802
6.50 to 7.00; (7.813 µm)	1.6170
7.00 to 7.50; (5.524 µm)	1.7727
7.50 to 8.00; (3.906 µm)	1.6244
8.00 to 8.50; (2.762 µm)	1.3001
8.50 to 9.00; (1.953 µm)	0.9580
9.00 to 9.50; (1.381 µm)	0.6042
9.50 to 10.00; (0.977 µm)	0.2975
10.00 to 10.50; (0.691 µm)	0.2492
10.50 to 11.00; (0.488 µm)	0.4546
11.00 to 11.50; (0.345 µm)	0.6842
11.50 to 12.00; (0.244 µm)	0.7090
12.00 to 12.50; (0.173 µm)	0.5207
12.50 to 13.00; (0.122 µm)	0.3259
13.00 to 13.50; (0.086 µm)	0.1640

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Exercise Code:	**PS55**
LabCode:	**PSA_BENCHMARK REPLICATE 2**
Sample Code:	**PS5521BMREP2**

Phi interval (explicit) + sieve mesh (theoretical sieves shown in brackets)	Volume/Weight (mark as "0" for not analysed or no material)
-6.50 to -6.00; 63 mm	**0.0000**
-6.00 to -5.50; 45 mm	**0.0000**
-5.50 to -5.00; 31.5 mm	**0.0000**
-5.00 to -4.50; 22.4 mm	**0.0000**
-4.50 to -4.00; 16 mm	**0.0000**
-4.00 to -3.50; 11.2 mm	**0.6354**
-3.50 to -3.00; 8 mm	**43.0156**
-3.00 to -2.50; 5.6 mm	**30.8310**
-2.50 to -2.00; 4 mm	**4.8347**
-2.00 to -1.50; 2.8 mm	**0.2979**
-1.50 to -1.00; 2 mm	**0.0055**
-1.00 to -0.50; 1.4 mm	**0.0000**
-0.50 to 0.00; 1 mm	**0.0000**
0.00 to 0.50; (707 µm)	0.0000
0.50 to 1.00; (500 µm)	0.0000
1.00 to 1.50; (353.6 µm)	0.0562
1.50 to 2.00; (250 µm)	1.0763
2.00 to 2.50; (176.8 µm)	1.2791
2.50 to 3.00; (125 µm)	0.4832
3.00 to 3.50; (88.39 µm)	0.3953
3.50 to 4.00; (62.5 µm)	0.3999
4.00 to 4.50; (44.19 µm)	0.5952
4.50 to 5.00; (31.25 µm)	0.7417
5.00 to 5.50; (22.097 µm)	1.0813
5.50 to 6.00; (15.625 µm)	1.2643
6.00 to 6.50; (11.049 µm)	1.3673
6.50 to 7.00; (7.813 µm)	1.7567
7.00 to 7.50; (5.524 µm)	1.9169
7.50 to 8.00; (3.906 µm)	1.7307
8.00 to 8.50; (2.762 µm)	1.3562
8.50 to 9.00; (1.953 µm)	0.9742
9.00 to 9.50; (1.381 µm)	0.6048
9.50 to 10.00; (0.977 µm)	0.3027
10.00 to 10.50; (0.691 µm)	0.2508
10.50 to 11.00; (0.488 µm)	0.4344
11.00 to 11.50; (0.345 µm)	0.6430
11.50 to 12.00; (0.244 µm)	0.6704
12.00 to 12.50; (0.173 µm)	0.5035
12.50 to 13.00; (0.122 µm)	0.3254
13.00 to 13.50; (0.086 µm)	0.1704

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Exercise Code:	**PS55**
LabCode:	**PSA_BENCHMARK REPLICATE 3**
Sample Code:	**PS5521BMREP3**

Phi interval (explicit) + sieve mesh (theoretical sieves shown in brackets)	Volume/Weight (mark as "0" for not analysed or no material)
-6.50 to -6.00; 63 mm	**0.0000**
-6.00 to -5.50; 45 mm	**0.0000**
-5.50 to -5.00; 31.5 mm	**0.0000**
-5.00 to -4.50; 22.4 mm	**0.0000**
-4.50 to -4.00; 16 mm	**0.0000**
-4.00 to -3.50; 11.2 mm	**1.3880**
-3.50 to -3.00; 8 mm	**43.5484**
-3.00 to -2.50; 5.6 mm	**30.3366**
-2.50 to -2.00; 4 mm	**4.3146**
-2.00 to -1.50; 2.8 mm	**0.3865**
-1.50 to -1.00; 2 mm	**0.0011**
-1.00 to -0.50; 1.4 mm	**0.0000**
-0.50 to 0.00; 1 mm	**0.0000**
0.00 to 0.50; (707 µm)	0.0000
0.50 to 1.00; (500 µm)	0.0000
1.00 to 1.50; (353.6 µm)	0.0388
1.50 to 2.00; (250 µm)	0.9282
2.00 to 2.50; (176.8 µm)	1.3412
2.50 to 3.00; (125 µm)	0.5715
3.00 to 3.50; (88.39 µm)	0.4167
3.50 to 4.00; (62.5 µm)	0.4101
4.00 to 4.50; (44.19 µm)	0.5650
4.50 to 5.00; (31.25 µm)	0.7094
5.00 to 5.50; (22.097 µm)	1.0364
5.50 to 6.00; (15.625 µm)	1.2178
6.00 to 6.50; (11.049 µm)	1.2882
6.50 to 7.00; (7.813 µm)	1.6769
7.00 to 7.50; (5.524 µm)	1.8467
7.50 to 8.00; (3.906 µm)	1.6621
8.00 to 8.50; (2.762 µm)	1.2914
8.50 to 9.00; (1.953 µm)	0.9364
9.00 to 9.50; (1.381 µm)	0.5847
9.50 to 10.00; (0.977 µm)	0.2709
10.00 to 10.50; (0.691 µm)	0.2330
10.50 to 11.00; (0.488 µm)	0.4777
11.00 to 11.50; (0.345 µm)	0.7437
11.50 to 12.00; (0.244 µm)	0.7644
12.00 to 12.50; (0.173 µm)	0.5419
12.50 to 13.00; (0.122 µm)	0.3213
13.00 to 13.50; (0.086 µm)	0.1501

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Exercise Code:	**PS55**
LabCode:	**PSA_BENCHMARK REPLICATE 4**
Sample Code:	**PS5521BMREP4**

Phi interval (explicit) + sieve mesh (theoretical sieves shown in brackets)	Volume/Weight (mark as "0" for not analysed or no material)
-6.50 to -6.00; 63 mm	**0.0000**
-6.00 to -5.50; 45 mm	**0.0000**
-5.50 to -5.00; 31.5 mm	**0.0000**
-5.00 to -4.50; 22.4 mm	**0.0000**
-4.50 to -4.00; 16 mm	**0.0000**
-4.00 to -3.50; 11.2 mm	**1.1687**
-3.50 to -3.00; 8 mm	**42.7952**
-3.00 to -2.50; 5.6 mm	**31.0217**
-2.50 to -2.00; 4 mm	**4.6608**
-2.00 to -1.50; 2.8 mm	**0.3423**
-1.50 to -1.00; 2 mm	**0.0033**
-1.00 to -0.50; 1.4 mm	**0.0000**
-0.50 to 0.00; 1 mm	**0.0000**
0.00 to 0.50; (707 µm)	0.0000
0.50 to 1.00; (500 µm)	0.0000
1.00 to 1.50; (353.6 µm)	0.0486
1.50 to 2.00; (250 µm)	0.9863
2.00 to 2.50; (176.8 µm)	1.2789
2.50 to 3.00; (125 µm)	0.6566
3.00 to 3.50; (88.39 µm)	0.4998
3.50 to 4.00; (62.5 µm)	0.4375
4.00 to 4.50; (44.19 µm)	0.5932
4.50 to 5.00; (31.25 µm)	0.7087
5.00 to 5.50; (22.097 µm)	1.0363
5.50 to 6.00; (15.625 µm)	1.2185
6.00 to 6.50; (11.049 µm)	1.3098
6.50 to 7.00; (7.813 µm)	1.6772
7.00 to 7.50; (5.524 µm)	1.8357
7.50 to 8.00; (3.906 µm)	1.6692
8.00 to 8.50; (2.762 µm)	1.3166
8.50 to 9.00; (1.953 µm)	0.9465
9.00 to 9.50; (1.381 µm)	0.5859
9.50 to 10.00; (0.977 µm)	0.2937
10.00 to 10.50; (0.691 µm)	0.2446
10.50 to 11.00; (0.488 µm)	0.4216
11.00 to 11.50; (0.345 µm)	0.6213
11.50 to 12.00; (0.244 µm)	0.6467
12.00 to 12.50; (0.173 µm)	0.4879
12.50 to 13.00; (0.122 µm)	0.3181
13.00 to 13.50; (0.086 µm)	0.1687

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Exercise Code:	**PS55**
LabCode:	**PSA_BENCHMARK REPLICATE 5**
Sample Code:	**PS5521BMREP5**

Phi interval (explicit) + sieve mesh (theoretical sieves shown in brackets)	Volume/Weight (mark as "0" for not analysed or no material)
-6.50 to -6.00; 63 mm	**0.0000**
-6.00 to -5.50; 45 mm	**0.0000**
-5.50 to -5.00; 31.5 mm	**0.0000**
-5.00 to -4.50; 22.4 mm	**0.0000**
-4.50 to -4.00; 16 mm	**0.0000**
-4.00 to -3.50; 11.2 mm	**0.5153**
-3.50 to -3.00; 8 mm	**43.0440**
-3.00 to -2.50; 5.6 mm	**32.2991**
-2.50 to -2.00; 4 mm	**4.0067**
-2.00 to -1.50; 2.8 mm	**0.3341**
-1.50 to -1.00; 2 mm	**0.0011**
-1.00 to -0.50; 1.4 mm	**0.0000**
-0.50 to 0.00; 1 mm	**0.0000**
0.00 to 0.50; (707 µm)	0.0000
0.50 to 1.00; (500 µm)	0.0000
1.00 to 1.50; (353.6 µm)	0.0365
1.50 to 2.00; (250 µm)	0.9054
2.00 to 2.50; (176.8 µm)	1.3526
2.50 to 3.00; (125 µm)	0.6192
3.00 to 3.50; (88.39 µm)	0.3767
3.50 to 4.00; (62.5 µm)	0.3661
4.00 to 4.50; (44.19 µm)	0.5586
4.50 to 5.00; (31.25 µm)	0.7121
5.00 to 5.50; (22.097 µm)	1.0625
5.50 to 6.00; (15.625 µm)	1.2327
6.00 to 6.50; (11.049 µm)	1.2901
6.50 to 7.00; (7.813 µm)	1.6196
7.00 to 7.50; (5.524 µm)	1.7725
7.50 to 8.00; (3.906 µm)	1.6277
8.00 to 8.50; (2.762 µm)	1.3084
8.50 to 9.00; (1.953 µm)	0.9645
9.00 to 9.50; (1.381 µm)	0.6066
9.50 to 10.00; (0.977 µm)	0.3001
10.00 to 10.50; (0.691 µm)	0.2500
10.50 to 11.00; (0.488 µm)	0.4476
11.00 to 11.50; (0.345 µm)	0.6701
11.50 to 12.00; (0.244 µm)	0.6969
12.00 to 12.50; (0.173 µm)	0.5190
12.50 to 13.00; (0.122 µm)	0.3321
13.00 to 13.50; (0.086 µm)	0.1721

Appendix 2. z-score calculations at each half phi-interval for participating laboratories and the benchmark average for PS55.

	Phi interval														
	-6.50 to -6.00	-6.00 to -5.50	-5.50 to -5.00	-5.00 to -4.50	-4.50 to -4.00	-4.00 to -3.50	z-score	-3.50 to -3.00	z-score	-3.00 to -2.50	z-score	-2.50 to -2.00	z-score	-2.00 to -1.50	z-score
Benchmark Average	0.00	0.00	0.00	0.00	0.00	0.833	-0.23	43.441	0.26	30.860	-0.05	4.528	0.45	0.342	0.02
PSA_2101	0.00	0.00	0.00	0.00	0.00	0.218	-0.73	39.617	-0.74	33.184	0.75	6.190	1.88	0.399	1.00
PSA_2102	0.00	0.00	0.00	0.00	0.00	0.000	-0.91	42.946	0.13	29.921	-0.37	6.497	2.15	0.403	1.08
PSA_2103	0.00	0.00	0.00	0.00	0.00	0.433	-0.56	43.063	0.16	32.638	0.56	3.448	-0.48	0.325	-0.28
PSA_2105	0.00	0.00	0.00	0.00	0.00	0.459	-0.54	44.801	0.62	29.809	-0.40	4.823	0.70	0.350	0.16
PSA_2106	0.00	0.00	0.00	0.00	0.00	1.314	0.17	43.008	0.15	32.778	0.61	3.798	-0.18	0.433	1.59
PSA_2107	0.00	0.00	0.00	0.00	0.00	0.484	-0.52	41.282	-0.30	35.323	1.48	4.014	0.00	0.360	0.33
PSA_2108	0.00	0.00	0.00	0.00	0.00	0.000	-0.91	44.213	0.46	31.553	0.19	4.096	0.07	0.231	-1.91
PSA_2109	0.00	0.00	0.00	0.00	0.00	1.030	-0.07	41.935	-0.13	31.648	0.22	3.647	-0.31	0.253	-1.52
PSA_2110	0.00	0.00	0.00	0.00	0.00	1.210	0.08	42.260	-0.05	33.680	0.92	3.010	-0.86	0.330	-0.19
PSA_2111	0.00	0.00	0.00	0.00	0.00	0.000	-0.91	31.988	-2.73	25.643	-1.83	3.380	-0.54	0.352	0.18
PSA_2112	0.00	0.00	0.00	0.00	0.00	2.519	1.15	40.446	-0.52	32.722	0.59	4.245	0.20	0.393	0.90
PSA_2113	0.00	0.00	0.00	0.00	0.00	4.569	2.83	46.141	0.97	26.508	-1.53	2.586	-1.23	0.255	-1.49
PSA_2113_a	0.00	0.00	0.00	0.00	0.00	1.753	0.52	49.999	1.97	25.971	-1.72	2.351	-1.43	0.339	-0.04
PSA_2114	0.00	0.00	0.00	0.00	0.00	1.870	0.62	41.540	-0.24	32.630	0.56	3.530	-0.41	0.350	0.16

MEAN	0.00	0.00	0.00	0.00	0.00	1.1128	42.4453	30.9912	4.0094	0.3410
STANDARD DEVIATION	0.00	0.00	0.00	0.00	0.00	1.2201	3.8280	2.9228	1.1598	0.0579

All labs recorded zero therefore the mean and standard deviation were also zero.

z<-1.96 or z >1.96

Appendix 2. z-score calculations at each half phi-interval for participating laboratories and the benchmark average for PS55.

	Phi interval															
	-1.50 to -1.00	z-score	-1.00 to -0.50	z-score	-0.50 to 0.00	z-score	0.00 to 0.50	z-score	0.50 to 1.00	z-score	1.00 to 1.50	z-score	1.50 to 2.00	z-score	2.00 to 2.50	z-score
Benchmark Average	0.002	-0.45	0.000	-0.52	0.000	-0.53	0.000	-0.53	0.000	-0.63	0.048	-0.90	0.984	-0.09	1.287	0.73
PSA_2101	0.001	-0.54	0.001	-0.38	0.002	-0.03	0.009	-0.28	0.145	-0.24	0.587	-0.04	1.047	0.02	1.329	0.82
PSA_2102	0.023	0.91	0.020	2.20	0.008	1.30	0.028	0.21	0.176	-0.16	0.486	-0.21	0.770	-0.43	0.714	-0.58
PSA_2103	0.001	-0.55	0.000	-0.52	0.001	-0.29	0.000	-0.53	0.695	1.22	2.200	2.52	2.626	2.57	1.935	2.21
PSA_2105	0.001	-0.54	0.000	-0.52	0.000	-0.53	0.000	-0.53	0.000	-0.63	0.058	-0.89	1.023	-0.02	1.181	0.49
PSA_2106	0.010	0.06	0.000	-0.52	0.000	-0.46	0.134	3.07	1.353	2.98	1.719	1.75	0.760	-0.45	0.644	-0.74
PSA_2107	0.010	0.06	0.000	-0.52	0.000	-0.53	0.000	-0.53	0.002	-0.62	0.168	-0.71	0.340	-1.13	0.376	-1.36
PSA_2108	0.001	-0.55	0.001	-0.41	0.001	-0.29	0.021	0.05	0.388	0.41	0.945	0.52	1.208	0.28	1.007	0.09
PSA_2109	0.014	0.28	0.000	-0.52	0.000	-0.53	0.033	0.35	0.032	-0.55	0.612	0.00	2.150	1.80	1.484	1.18
PSA_2110	0.000	-0.61	0.010	0.85	0.000	-0.53	0.000	-0.53	0.110	-0.34	0.390	-0.36	0.580	-0.74	0.510	-1.05
PSA_2111	0.000	-0.61	0.000	-0.52	0.000	-0.53	0.070	1.35	0.514	0.74	1.038	0.67	1.320	0.46	1.043	0.17
PSA_2112	0.005	-0.27	0.001	-0.38	0.001	-0.28	0.000	-0.53	0.017	-0.59	0.189	-0.68	0.381	-1.06	0.373	-1.36
PSA_2113	0.002	-0.48	0.003	-0.11	0.005	0.67	0.000	-0.53	0.000	-0.63	0.101	-0.82	0.831	-0.33	1.114	0.33
PSA_2113_a	0.059	3.26	0.021	2.41	0.015	3.08	0.000	-0.53	0.014	-0.59	0.224	-0.62	0.756	-0.46	0.790	-0.41
PSA_2114	0.010	0.04	0.000	-0.52	0.000	-0.53	0.000	-0.53	0.100	-0.36	0.460	-0.25	0.780	-0.42	0.740	-0.52

MEAN	0.0093	0.0038	0.0022	0.0197	0.2364	0.6149	1.0370	0.9684
STANDARD DEVIATION	0.0152	0.0073	0.0042	0.0373	0.3747	0.6292	0.6174	0.4372

z<-1.96 or z >1.96

Appendix 2. z-score calculations at each half phi-interval for participating laboratories and the benchmark average for PS55.

	Phi interval															
	2.50 to 3.00	z-score	3.00 to 3.50	z-score	3.50 to 4.00	z-score	4.00 to 4.50	z-score	4.50 to 5.00	z-score	5.00 to 5.50	z-score	5.50 to 6.00	z-score	6.00 to 6.50	z-score
Benchmark Average	0.579	0.13	0.421	0.43	0.405	-0.20	0.577	-0.40	0.72	-0.51	1.05	-0.23	1.23	-0.55	1.31	-0.45
PSA_2101	0.897	1.59	0.607	1.60	0.599	0.89	0.641	-0.33	0.80	-0.28	0.97	-0.42	1.21	-0.57	1.43	-0.28
PSA_2102	0.343	-0.96	0.135	-1.38	0.307	-0.75	0.666	-0.30	1.01	0.34	1.30	0.34	1.59	-0.03	1.90	0.41
PSA_2103	0.980	1.97	0.583	1.45	0.818	2.12	1.219	0.38	1.40	1.50	1.34	0.44	1.18	-0.63	1.01	-0.88
PSA_2105	0.566	0.07	0.418	0.40	0.410	-0.17	0.574	-0.41	0.70	-0.54	1.04	-0.25	1.22	-0.57	1.28	-0.49
PSA_2106	0.274	-1.28	0.452	0.62	0.465	0.14	0.817	-0.11	1.11	0.64	1.45	0.68	1.24	-0.53	1.47	-0.22
PSA_2107	0.320	-1.06	0.333	-0.13	0.446	0.03	0.642	-0.32	0.81	-0.25	1.03	-0.29	1.32	-0.42	1.71	0.13
PSA_2108	0.618	0.31	0.406	0.33	0.470	0.16	0.687	-0.27	0.92	0.08	1.12	-0.07	1.32	-0.42	1.53	-0.13
PSA_2109	0.733	0.84	0.150	-1.28	0.255	-1.04	3.750	3.49	0.00	-2.61	0.00	-2.67	3.80	3.10	0.00	-2.34
PSA_2110	0.380	-0.79	0.350	-0.02	0.460	0.11	0.640	-0.33	0.84	-0.15	1.13	-0.05	1.49	-0.18	1.83	0.30
PSA_2111	0.729	0.82	0.482	0.81	0.716	1.54	1.162	0.31	1.53	1.89	2.16	2.33	2.64	1.46	3.35	2.49
PSA_2112	0.338	-0.98	0.299	-0.34	0.446	0.03	0.579	-0.40	0.88	-0.03	1.11	-0.09	1.44	-0.25	1.84	0.32
PSA_2113	0.620	0.32	0.167	-1.18	0.174	-1.49	0.478	-0.53	0.84	-0.15	1.13	-0.06	1.46	-0.22	1.90	0.40
PSA_2113_a	0.370	-0.83	0.094	-1.64	0.168	-1.53	0.547	-0.44	0.99	0.28	1.36	0.48	1.71	0.13	2.05	0.62
PSA_2114	0.520	-0.14	0.410	0.35	0.470	0.17	0.620	-0.35	0.82	-0.21	1.10	-0.12	1.39	-0.32	1.70	0.12

MEAN	0.5512	0.3538	0.4405	0.9066	0.89	1.15	1.62	1.62
STANDARD DEVIATION	0.2171	0.1586	0.1786	0.8147	0.34	0.43	0.70	0.69

z<-1.96 or z >1.96

Appendix 2. z-score calculations at each half phi-interval for participating laboratories and the benchmark average for PS55.

	Phi interval															
	6.50 to 7.00	z-score	7.00 to 7.50	z-score	7.50 to 8.00	z-score	8.00 to 8.50	z-score	8.50 to 9.00	z-score	9.00 to 9.50	z-score	9.50 to 10.00	z-score	10.00 to 10.50	z-score
Benchmark Average	1.67	-0.26	1.83	-0.17	1.66	-0.42	1.31	-0.22	0.96	-0.05	0.60	0.08	0.29	-0.25	0.25	-0.31
PSA_2101	1.63	-0.31	1.70	-0.31	1.54	-0.48	1.22	-0.36	0.88	-0.21	0.62	0.15	0.44	0.42	0.38	0.21
PSA_2102	2.19	0.36	2.36	0.37	2.27	-0.09	1.88	0.60	1.27	0.64	0.63	0.18	0.16	-0.84	0.00	-1.26
PSA_2103	0.88	-1.20	0.76	-1.27	0.65	-0.97	0.54	-1.34	0.41	-1.26	0.28	-0.99	0.21	-0.62	0.19	-0.52
PSA_2105	1.62	-0.33	1.77	-0.23	1.62	-0.44	1.30	-0.24	0.96	-0.05	0.60	0.11	0.30	-0.23	0.25	-0.29
PSA_2106	1.36	-0.63	0.98	-1.04	1.21	-0.66	1.06	-0.58	0.86	-0.26	0.49	-0.27	0.47	0.52	0.26	-0.24
PSA_2107	2.06	0.20	2.29	0.30	2.10	-0.18	1.60	0.19	1.09	0.23	0.67	0.35	0.42	0.29	0.38	0.22
PSA_2108	1.74	-0.18	1.84	-0.17	1.72	-0.39	1.37	-0.13	0.93	-0.10	0.58	0.01	0.40	0.21	0.34	0.06
PSA_2109	0.00	-2.24	0.00	-2.04	8.48	3.30	0.00	-2.11	0.00	-2.14	0.00	-1.94	0.00	-1.55	0.00	-1.26
PSA_2110	2.25	0.42	2.36	0.37	2.12	-0.17	1.62	0.22	0.99	0.03	0.51	-0.21	0.38	0.14	0.57	0.95
PSA_2111	3.91	2.39	4.31	2.36	3.99	0.86	3.10	2.36	2.18	2.64	1.45	2.97	0.97	2.76	0.96	2.46
PSA_2112	2.35	0.54	2.77	0.79	2.79	0.20	2.15	0.99	1.21	0.50	0.48	-0.32	0.03	-1.41	0.00	-1.26
PSA_2113	2.29	0.47	2.43	0.44	2.17	-0.14	1.61	0.21	0.99	0.03	0.56	-0.05	0.38	0.13	0.34	0.06
PSA_2113_a	2.27	0.44	2.27	0.27	1.99	-0.24	1.50	0.04	0.95	-0.07	0.54	-0.13	0.35	-0.02	0.30	-0.12
PSA_2114	2.17	0.33	2.31	0.32	2.08	-0.19	1.70	0.34	1.01	0.07	0.59	0.06	0.45	0.45	0.66	1.30

MEAN	1.89	2.00	2.43	1.46	0.98	0.57	0.35	0.33
STANDARD DEVIATION	0.85	0.98	1.83	0.69	0.46	0.29	0.23	0.26

z<-1.96 or z >1.96

Appendix 2. z-score calculations at each half phi-interval for participating laboratories and the benchmark average for PS55.

	Phi interval											
	10.50 to 11.00	z-score	11.00 to 11.50	z-score	11.50 to 12.00	z-score	12.00 to 12.50	z-score	12.50 to 13.00	z-score	13.00 to 13.50	z-score
Benchmark Average	0.45	1.06	0.67	2.12	0.70	2.27	0.51	2.29	0.32	2.29	0.17	2.13
PSA_2101	0.39	0.80	0.40	1.00	0.36	0.95	0.26	0.92	0.17	0.95	0.12	1.49
PSA_2102	0.00	-1.00	0.00	-0.69	0.00	-0.46	0.00	-0.46	0.00	-0.46	0.00	-0.48
PSA_2103	0.15	-0.33	0.04	-0.50	0.00	-0.46	0.00	-0.46	0.00	-0.46	0.00	-0.48
PSA_2105	0.45	1.10	0.68	2.17	0.71	2.32	0.52	2.32	0.33	2.30	0.16	2.12
PSA_2106	0.07	-0.69	0.00	-0.69	0.00	-0.46	0.00	-0.46	0.00	-0.46	0.00	-0.48
PSA_2107	0.29	0.35	0.13	-0.16	0.00	-0.46	0.00	-0.46	0.00	-0.46	0.00	-0.48
PSA_2108	0.26	0.20	0.09	-0.31	0.00	-0.46	0.00	-0.46	0.00	-0.46	0.00	-0.48
PSA_2109	0.00	-1.00	0.00	-0.69	0.00	-0.46	0.00	-0.46	0.00	-0.46	0.00	-0.48
PSA_2110	0.00	-1.00	0.00	-0.69	0.00	-0.46	0.00	-0.46	0.00	-0.46	0.00	-0.48
PSA_2111	0.71	2.28	0.30	0.56	0.00	-0.46	0.00	-0.46	0.00	-0.46	0.00	-0.48
PSA_2112	0.00	-1.00	0.00	-0.69	0.00	-0.46	0.00	-0.46	0.00	-0.46	0.00	-0.48
PSA_2113	0.27	0.22	0.08	-0.33	0.00	-0.46	0.00	-0.46	0.00	-0.46	0.00	-0.48
PSA_2113_a	0.22	0.03	0.06	-0.43	0.00	-0.46	0.00	-0.46	0.00	-0.46	0.00	-0.48
PSA_2114	0.00	-1.00	0.00	-0.69	0.00	-0.46	0.00	-0.46	0.00	-0.46	0.00	-0.48

MEAN	0.22	0.16	0.12	0.09	0.05	0.03
STANDARD DEVIATION	0.22	0.24	0.26	0.19	0.12	0.06

z<-1.96 or z >1.96