The National Marine Biological
Analytical Quality Control Scheme
www.nmbaqcs.org

Particle Size Results – PS46

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Table 1. Summary of the replicate benchmark analysis and particle size information received from participating laboratories for the forty-sixth PSA NMBAQC Scheme

Benchmark Data

Sample	Method	% Gravel	% Sand	% Silt	Median ϕ	Mean ϕ	Sediment Description (Post analysis)
PS46 1960	NMBAQC	98.76	1.23	0.01	-2.839	-2.988	Gravel
PS46 1961	NMBAQC	98.75	1.24	0.01	-2.844	-2.995	Gravel
PS46 1962	NMBAQC	98.24	1.72	0.04	-2.829	-2.981	Gravel
PS46 1963	NMBAQC	98.98	1.01	0.00	-2.871	-3.015	Gravel
PS46 1964	NMBAQC	99.08	0.91	0.02	-2.844	-2.986	Gravel
PS46 1965	NMBAQC	98.97	1.01	0.01	-2.834	-2.987	Gravel
PS46 1966	NMBAQC	98.57	1.39	0.03	-2.838	-2.983	Gravel
PS46 1967	NMBAQC	98.72	1.27	0.00	-2.876	-3.002	Gravel
PS46 1968	NMBAQC	98.96	1.00	0.03	-2.825	-2.962	Gravel
PS46 1969	NMBAQC	98.32	1.65	0.03	-2.833	-2.979	Gravel
TUM AVERAGE	NMBAQC	98.74	1.24	0.02	-2.843	-2.988	

Participant Data

Lab	Method	% Gravel	% Sand	% Silt	Sediment Description (Post analysis)
LB_1901	NMBAQC	98.49	1.49	0.01	Gravel
LB_1903	NMBAQC	98.77	1.21	0.02	Gravel
LB_1904	NMBAQC	99.15	0.85	0.00	Gravel
LB_1905	NMBAQC	98.83	1.07	0.10	Gravel
LB_1908	OTHER	99.32	0.67	0.01	Gravel
LB_1909	NMBAQC	99.05	0.95	0.00	Gravel
LB_1910	NMBAQC	98.21	1.75	0.05	Gravel
LB_1917	NMBAQC	99.22	0.78	0.00	Gravel
LB_1921	NMBAQC	91.71	8.20	0.09	Gravel
LB_1955	NMBAQC	99.47	0.52	0.01	Gravel
LB_1958	NMBAQC	99.21	0.79	0.00	Gravel

Key to methods

NMBAQC - States following NMBAQC PSA SOP for supporting biological data

OTHER - Following a different SOP.

Figure 1. Benchmark particle size distribution curves for PS46 resulting from analysis of ten replicate samples.

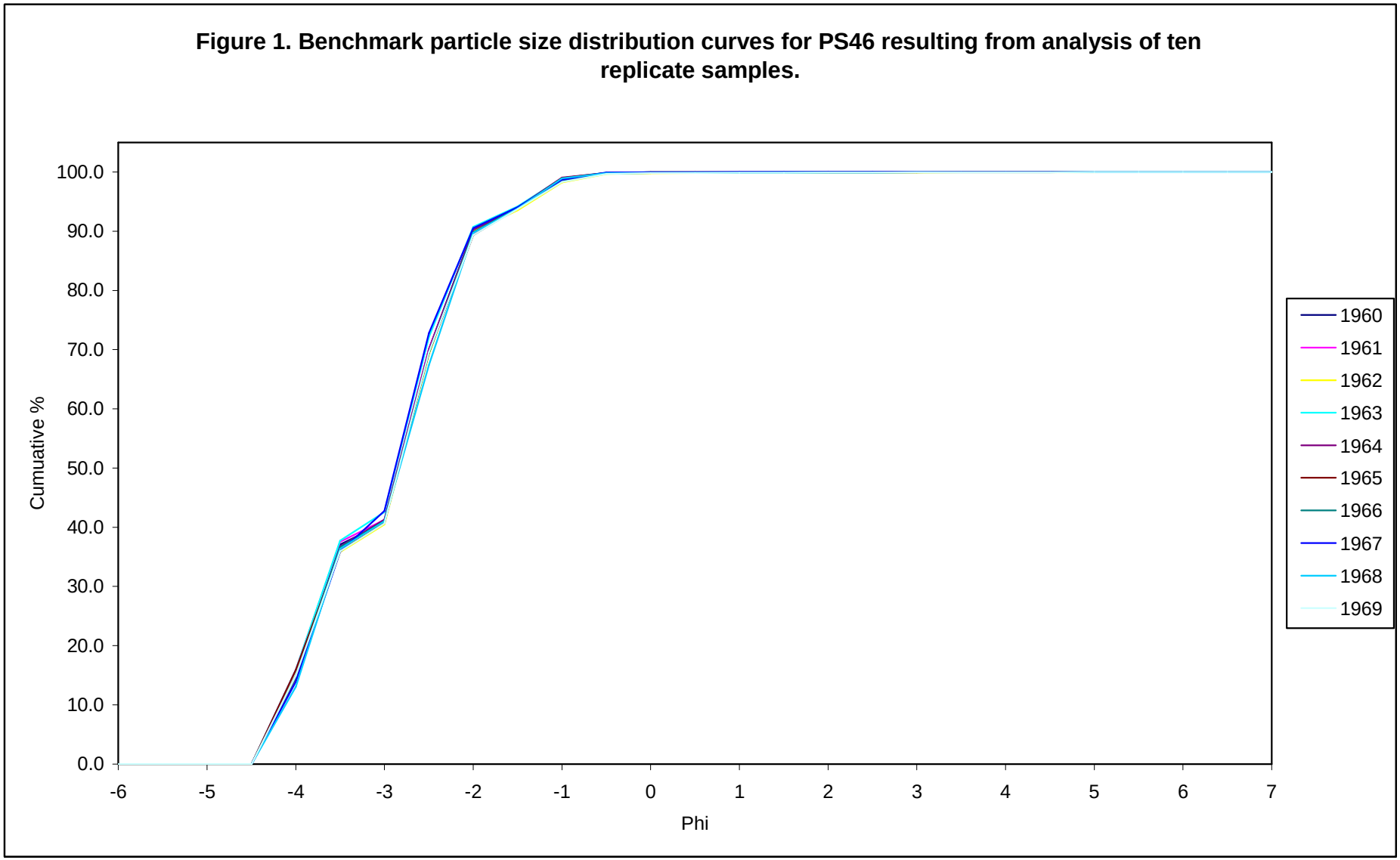


Figure 2. Particle size distribution curves from all participating laboratories for sediment samples from PS46.

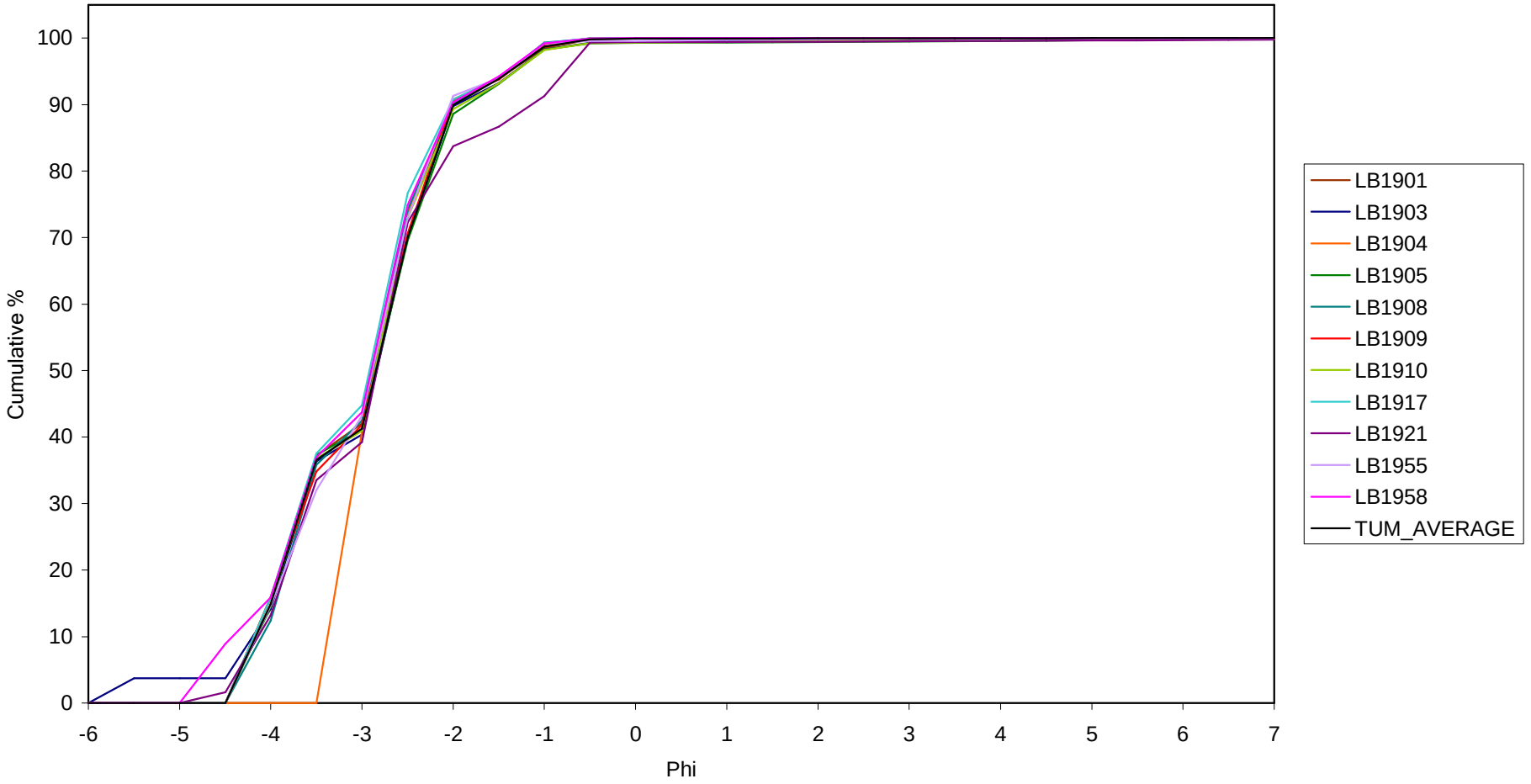


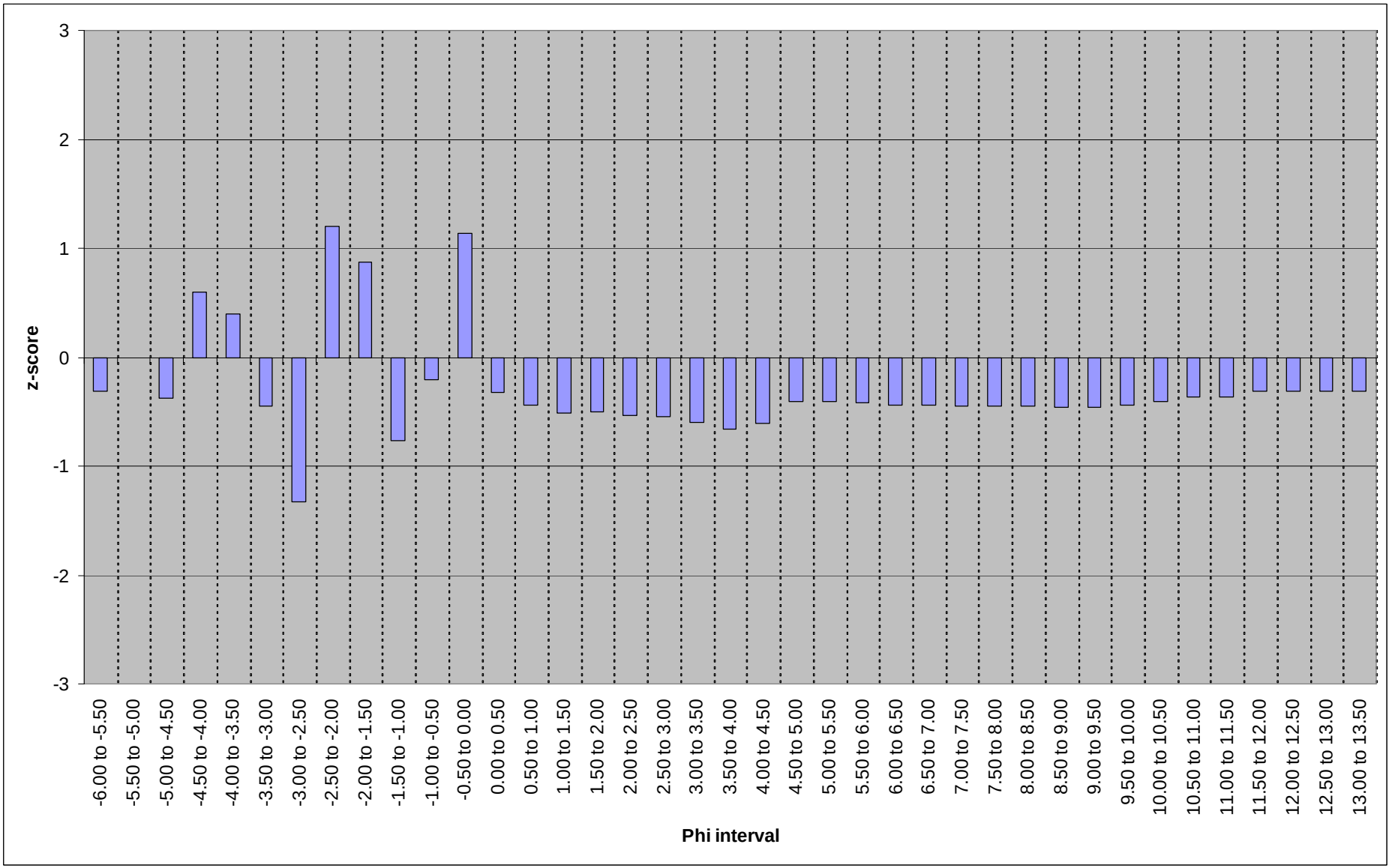
Table 2. Summary of z-scores for each half-phi interval for PS46; data from all participating laboratories included in mean and standard deviation calculations.

	-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
TUM AVERAGE	0.000	-0.315	0.000	-0.373	0.599693	0.392314	-0.450226	-1.331689	1.198029	0.871975	-0.769393	-0.201382	1.135524	-0.325688	-0.439492	-0.508044	-0.507679	-0.535717	-0.545724	-0.597589
LB1901	0.000	-0.314918	0.000	-0.372641	0.799915	0.340257	-0.436998	0.054926	0.188728	0.147047	-1.787937	-0.106717	2.512321	0.158774	-0.220649	-0.504915	-0.57171	-0.632834	-0.615591	-0.699844
LB1903	0.000	3.149183	0.000	-0.372641	-0.367095	0.483377	-0.517807	-0.757784	1.110628	-0.028397	0.001698	-0.233429	0.192709	1.266875	2.268801	2.163059	1.209647	1.374654	1.075355	1.721417
LB1904	0.000	-0.314918	0.000	-0.372641	-2.548926	-3.03069	3.07502	1.148197	0.114402	-0.519517	0.663015	-0.340667	0.121438	-0.805094	-0.832812	-0.809588	-0.706663	-0.786599	-0.761839	-0.930601
LB1905	0.000	-0.314918	0.000	-0.372641	0.508833	0.570018	-0.529356	-1.57973	0.86663	2.01546	0.386347	-0.27133	0.043232	0.395744	0.333511	0.135379	-0.053193	0.158186	0.317032	1.253715
LB1908	0.000	-0.314918	0.000	-0.372641	0.063674	0.673623	-0.256538	0.460107	-0.331452	0.569621	1.374739	-0.439912	-1.041054	-0.556156	-0.649501	-0.617149	-0.354243	-0.431645	-0.466597	-0.662168
LB1909	0.000	-0.314918	0.000	-0.372641	0.803462	-0.039152	-0.222366	-1.329057	1.264863	-0.820474	0.737569	-0.278914	-0.648601	-0.805094	-0.832812	-0.809588	-0.706663	-0.786599	-0.761839	-0.930601
LB1910	0.000	-0.314918	0.000	-0.372641	0.568453	0.440322	-0.49678	0.677453	-0.173078	0.748674	-0.131246	-0.221532	0.60572	0.394407	0.75153	1.560687	2.606465	2.363499	2.554621	1.059299
LB1917	0.000	-0.314918	0.000	-0.372641	0.816925	0.377042	-0.201178	0.611752	-1.044293	-0.448429	0.534083	-0.356718	-0.998801	-0.805094	-0.832812	-0.809588	-0.706663	-0.786599	-0.761839	-0.930601
LB1921	0.000	-0.314918	0.000	0.262836	-0.112831	0.181074	-0.348716	1.289732	-2.054537	-0.963557	-1.891573	3.138594	0.215558	-0.775341	-0.411518	-0.101004	-0.169658	-0.092611	0.023815	0.7146
LB1955	0.000	-0.314918	0.000	-0.372641	0.555919	-0.294028	0.181684	-0.701859	0.575877	-1.578144	0.475542	-0.526436	-0.632709	2.336074	1.259075	0.602295	0.159343	0.407149	0.158721	0.335385
LB1958	0.000	-0.314918	0.000	3.050934	-1.088328	0.298157	-0.244965	0.126265	-0.517767	0.877717	-0.362236	-0.362939	-0.369813	-0.805094	-0.832812	-0.809588	-0.706663	-0.786599	-0.761839	-0.930601
Mean	0.000	0.342732	0.000	0.96227	12.08068	19.20386	9.283497	30.93658	16.80542	3.476638	5.05593	1.491105	0.066697	0.019852	0.022723	0.024867	0.030087	0.026702	0.028745	0.02128
St Dev	0.000	1.088319	0.000	2.582296	4.739518	6.336466	10.25129	1.620241	2.60916	0.510274	0.264063	2.088788	0.032621	0.024658	0.027285	0.030716	0.042576	0.033946	0.037731	0.022867

	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
TUM AVERAGE	-0.65624	-0.613233	-0.410296	-0.410121	-0.42125	-0.434128	-0.443665	-0.449925	-0.452197	-0.454816	-0.455803	-0.45776	-0.438003	-0.404905	-0.365653	-0.362117	-0.314918	-0.314918	-0.314918	-0.314918
LB1901	-0.709639	-0.672006	-0.478428	-0.464597	-0.464018	-0.471383	-0.476459	-0.475957	-0.471728	-0.467255	-0.45696	-0.43789	-0.438003	-0.404905	-0.365653	-0.362117	-0.314918	-0.314918	-0.314918	-0.314918
LB1903	0.88286	0.450801	0.227478	-0.012664	-0.1105	-0.175471	-0.231689	-0.276464	-0.296902	-0.29808	-0.301838	-0.29981	-0.259711	-0.186852	-0.127067	-0.362117	-0.314918	-0.314918	-0.314918	-0.314918
LB1904	-0.884216	-0.827258	-0.607361	-0.562535	-0.541298	-0.535054	-0.532101	-0.52579	-0.517969	-0.510554	-0.494685	-0.466027	-0.438003	-0.404905	-0.365653	-0.362117	-0.314918	-0.314918	-0.314918	-0.314918
LB1905	1.374347	1.998253	2.63738	2.668167	2.578771	2.3981	2.20114	1.956379	1.759109	1.592372	1.318874	0.91283	0.541902	0.138546	-0.303214	-0.362117	-0.314918	-0.314918	-0.314918	-0.314918
LB1908	-0.639419	-0.653956	-0.453647	-0.477311	-0.506126	-0.517102	-0.512319	-0.503131	-0.496854	-0.493453	-0.481966	-0.455834	-0.426437	-0.393583	-0.362939	-0.362117	-0.314918	-0.314918	-0.314918	-0.314918
LB1909	-0.884216	-0.827258	-0.607361	-0.562535	-0.541298	-0.535054	-0.532101	-0.52579	-0.517969	-0.510554	-0.494685	-0.466027	-0.438003	-0.404905	-0.365653	-0.362117	-0.314918	-0.314918	-0.314918	-0.314918
LB1910	1.837818	1.326582	-0.607361	-0.562535	-0.541298	-0.535054	-0.532101	-0.52579	-0.517969	-0.510554	-0.494685	-0.466027	-0.438003	-0.404905	-0.365653	-0.362117	-0.314918	-0.314918	-0.314918	-0.314918
LB1917	-0.884216	-0.827258	-0.607361	-0.562535	-0.541298	-0.535054	-0.532101	-0.52579	-0.517969	-0.510554	-0.494685	-0.466027	-0.438003	-0.404905	-0.365653	-0.362117	-0.314918	-0.314918	-0.314918	-0.314918
LB1921	0.717035	1.026885	1.241072	1.290029	1.472658	1.741869	1.981145	2.228956	2.393852	2.516422	2.688561	2.88516	3.012075	3.099206	3.132764	3.110898	-0.314918	-0.314918	-0.314918	-0.314918
LB1955	0.07386	-0.167527	-0.137052	-0.190953	-0.264293	-0.300742	-0.301312	-0.298831	-0.29768	-0.297234	-0.293259	-0.27452	-0.239811	-0.227883	-0.145628	0.148157	3.149183	3.149183	3.149183	3.149183
LB1958	-0.884216	-0.827258	-0.607361	-0.562535	-0.541298	-0.535054	-0.532101	-0.52579	-0.517969	-0.510554	-0.494685	-0.466027	-0.438003	-0.404905	-0.365653	-0.362117	-0.314918	-0.314918	-0.314918	-0.314918
Mean	0.022172	0.017477	0.011113	0.009783	0.008835	0.008209	0.007703	0.007391	0.006894	0.006031	0.004939	0.0037	0.002498	0.001969	0.001127	0.000383	3.9E-05	2.97E-05	2.23E-05	1.43E-05
St Dev	0.025075	0.021127	0.018296	0.017391	0.016322	0.015343	0.014476	0.014057	0.01331	0.011812	0.009985	0.00794	0.005703	0.004862	0.003082	0.001058	0.000124	9.42E-05	7.07E-05	4.55E-05

z-score >1.96 or <-1.96
All values equal zero

Figure 3. Summary of z-scores for the benchmark data (TUM Average); when data from all participating laboratories are included in mean and standard deviation calculations.



Results of SIMPROF testing on PSA Ring test PS46 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 Euclidean distance between two samples (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 including a SIMPROF test at a 5% significance level. The red SIMPROF lines on the dendrogram indicate labs that cannot be distinguished from each other at the 5% significance level; the black lines indicate labs that can be distinguished from each other. The results are presented as a cluster dendrogram (Figure 4) and non-metric Multi-Dimensional Scaling (MDS) diagrams (Figures 5) below. It is important to note that, although the MDS plot is bounded by a box, the box does not represent either axes or scale. Two samples with a high similarity index will appear close together while those less similar will appear further apart. The ' correct' configuration of sample points will be multidimensional and the plot represents the best 2-dimensional solution to the problem. The technique should be viewed as complementary to cluster analysis, offering a different perspective of the same information.

Figure 4. Cluster dendrogram of PS46 including all laboratories, with the benchmark replicates (TUM average).

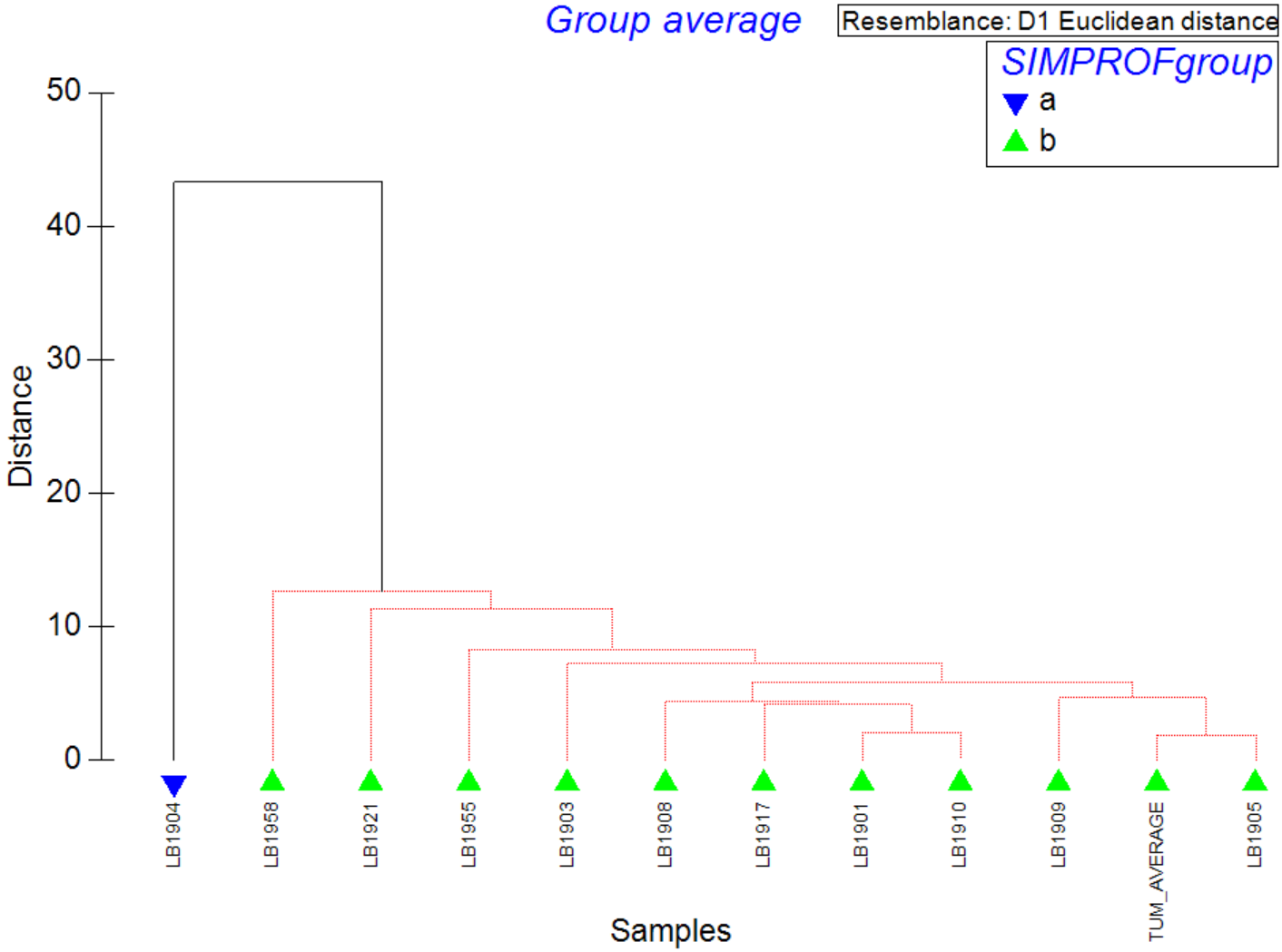
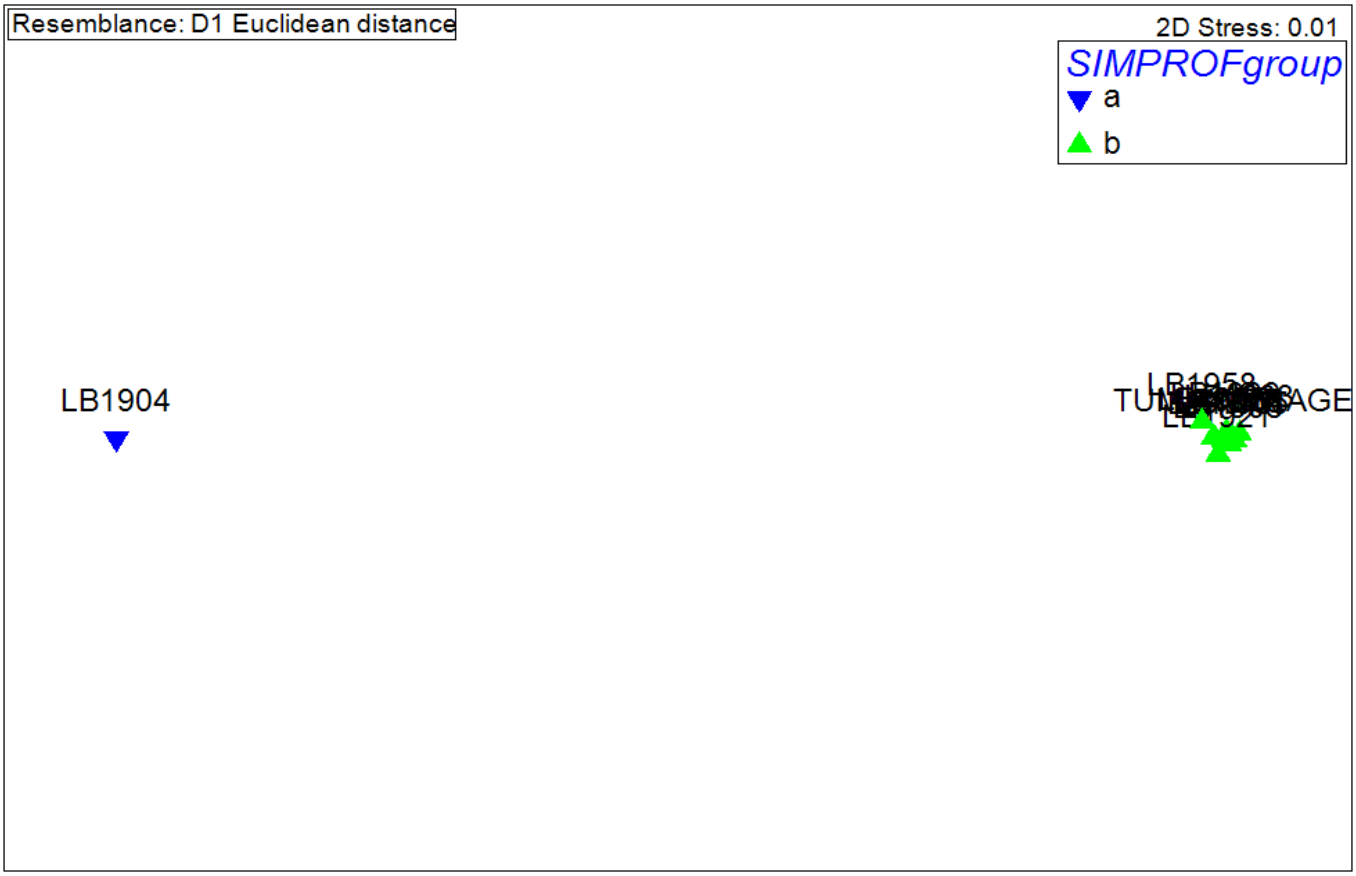
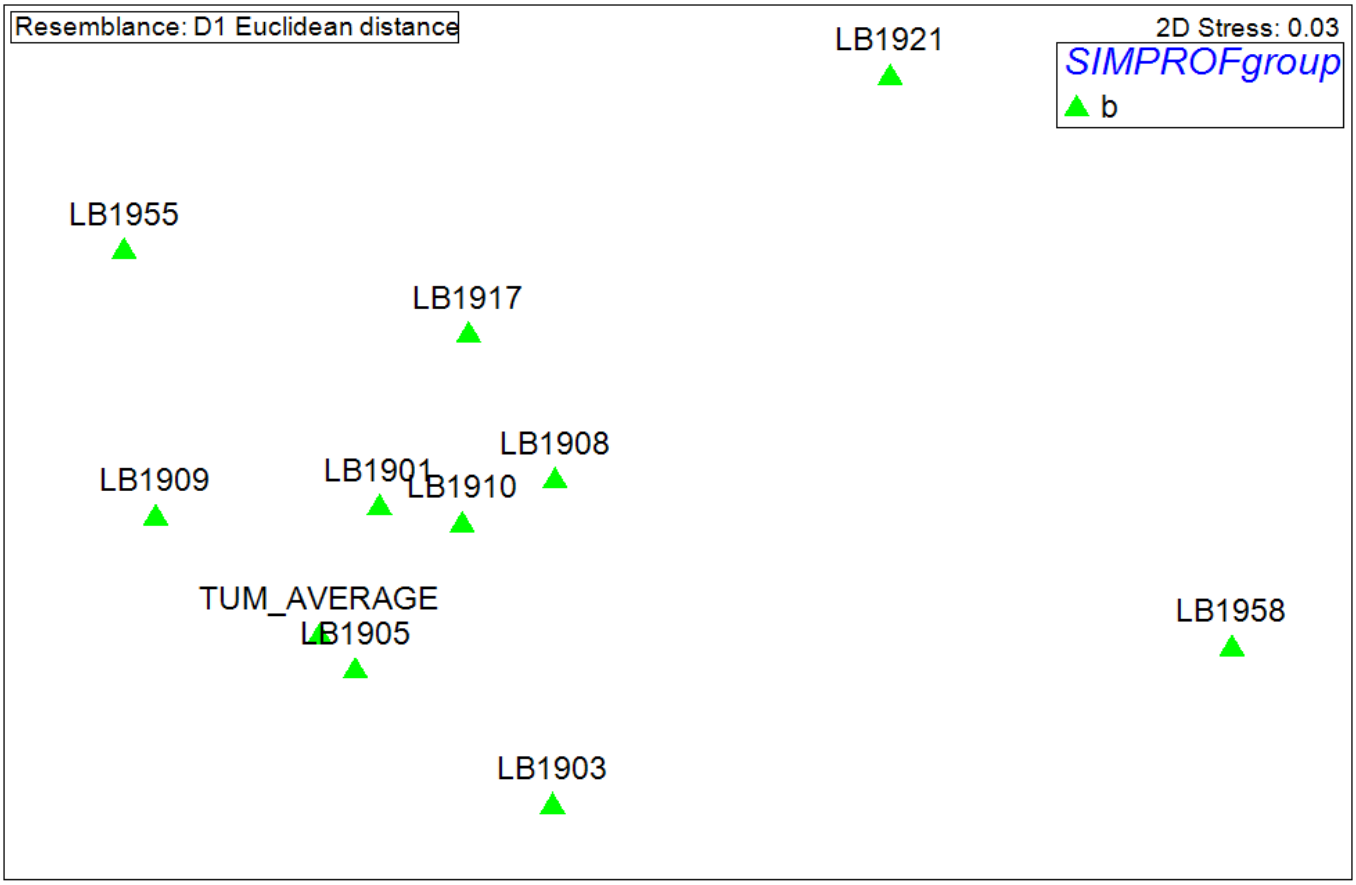


Figure 5. MDS plots of PS46 with the benchmark replicates (TUM AVERAGE) averaged; (a) including all laboratories and (b) a subset of cluster group b.

5a.



5b.



The cluster analysis separates the laboratories into 2 SIMPROF cluster groups; one of these groups comprises of a single lab.

Cluster group A is formed of the single laboratory (LB1904), figure 2 shows that their cumulative percentage is displaced by one phi and rises sharply between -3.5 and -3 phi. This could be due to a data entry error.

Cluster group B consists of all other laboratories including the TUM average (LB1901, LB1903, LB1905, LB1908, LB1909, LB1910, LB1917, LB1921, LB1955, and LB1958). These laboratories cumulative frequency curves (figure 2) are all fairly similar, with small variations below -4.5 phi for labs LB1903 and LB1958.

Appendices

Appendix 1. Final Summary Data sheets as supplied by participating laboratories (arranged by Lab Code).

Exercise Code:	**PS46**
LabCode:	**LB1901**
Sample Code:	**PS461901**
Equipment used (e.g. laser model and range):	**Endecotts Test Sieves, Malvern Mastersizer 2000 Laser Diffractor (Model: MAL1002178)**
Method used:	**NMBAQC PSA SOP for supporting biological data***
Peroxide pre-treatment used:	**NO***
Chemical dispersant used:	**NO***
Phi interval (explicit) + sieve mesh (theoretical sieves shown in brackets)	**Volume % (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	**15.8719**
-4.00 to -3.50; 11.2 mm	**21.3599**
-3.50 to -3.00; 8 mm	**4.8037**
-3.00 to -2.50; 5.6 mm	**31.0256**
-2.50 to -2.00; 4 mm	**17.2978**
-2.00 to -1.50; 2.8 mm	**3.5517**
-1.50 to -1.00; 2 mm	**4.5838**
-1.00 to -0.50; 1.4 mm	**1.2682**
-0.50 to 0.00; 1 mm	**0.1487**
0.00 to 0.50; (707 µm)	0.0238
0.50 to 1.00; (500 µm)	0.0167
1.00 to 1.50; (353.6 µm)	0.0094
1.50 to 2.00; (250 µm)	0.0057
2.00 to 2.50; (176.8 µm)	0.0052
2.50 to 3.00; (125 µm)	0.0055
3.00 to 3.50; (88.39 µm)	0.0053
3.50 to 4.00; (62.5 µm)	0.0044
4.00 to 4.50; (44.19 µm)	0.0033
4.50 to 5.00; (31.25 µm)	0.0024
5.00 to 5.50; (22.097 µm)	0.0017
5.50 to 6.00; (15.625 µm)	0.0013
6.00 to 6.50; (11.049 µm)	0.0010
6.50 to 7.00; (7.813 µm)	0.0008
7.00 to 7.50; (5.524 µm)	0.0007
7.50 to 8.00; (3.906 µm)	0.0006
8.00 to 8.50; (2.762 µm)	0.0005
8.50 to 9.00; (1.953 µm)	0.0004
9.00 to 9.50; (1.381 µm)	0.0002
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

Exercise Code:	PS46
LabCode:	LB1903
Sample Code:	PS461903
Equipment used (e.g. laser model and range):	*Malvern 2000 (0.02 - 2000 µm) Hydro G*
Method used:	NMBAQC PSA SOP for supporting biological data*
Peroxide pre-treatment used:	NO*
Chemical dispersant used:	NO*
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	**16.5300**
-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	**45.3400**
-4.00 to -3.50; 11.2 mm	**97.6300**
-3.50 to -3.00; 8 mm	**17.4300**
-3.00 to -2.50; 5.6 mm	**130.2600**
-2.50 to -2.00; 4 mm	**86.3900**
-2.00 to -1.50; 2.8 mm	**15.1800**
-1.50 to -1.00; 2 mm	**22.1700**
-1.00 to -0.50; 1.4 mm	**4.4000**
-0.50 to 0.00; 1 mm	**0.3200**
0.00 to 0.50; (707 µm)	0.0511
0.50 to 1.00; (500 µm)	0.0846
1.00 to 1.50; (353.6 µm)	0.0913
1.50 to 2.00; (250 µm)	0.0816
2.00 to 2.50; (176.8 µm)	0.0734
2.50 to 3.00; (125 µm)	0.0693
3.00 to 3.50; (88.39 µm)	0.0606
3.50 to 4.00; (62.5 µm)	0.0443
4.00 to 4.50; (44.19 µm)	0.0270
4.50 to 5.00; (31.25 µm)	0.0153
5.00 to 5.50; (22.097 µm)	0.0096
5.50 to 6.00; (15.625 µm)	0.0070
6.00 to 6.50; (11.049 µm)	0.0055
6.50 to 7.00; (7.813 µm)	0.0043
7.00 to 7.50; (5.524 µm)	0.0035
7.50 to 8.00; (3.906 µm)	0.0029
8.00 to 8.50; (2.762 µm)	0.0025
8.50 to 9.00; (1.953 µm)	0.0019
9.00 to 9.50; (1.381 µm)	0.0013
9.50 to 10.00; (0.977 µm)	0.0010
10.00 to 10.50; (0.691 µm)	0.0011
10.50 to 11.00; (0.488 µm)	0.0007
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

Exercise Code:	PS46
LabCode:	LB1904
Sample Code:	PS461904
Equipment used (e.g. laser model and range):	Fritsch Sieve Shaker
Method used:	NMBAQC PSA SOP for supporting biological data*
Peroxide pre-treatment used:	NO*
Chemical dispersant used:	NO*
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	**179.0300**
-3.00 to -2.50; 5.6 mm	**143.8900**
-2.50 to -2.00; 4 mm	**75.0400**
-2.00 to -1.50; 2.8 mm	**14.0900**
-1.50 to -1.00; 2 mm	**22.9500**
-1.00 to -0.50; 1.4 mm	**3.4200**
-0.50 to 0.00; 1 mm	**0.3100**
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)	0.0000
1.50 to 2.00; (250 µm)	0.0000
2.00 to 2.50; (176.8 µm)	0.0000
2.50 to 3.00; (125 µm)	0.0000
3.00 to 3.50; (88.39 µm)	0.0000
3.50 to 4.00; (62.5 µm)	0.0000
4.00 to 4.50; (44.19 µm)	0.0000
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)	0.0000
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)	0.0000
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

Exercise Code:	PS46
LabCode:	LB1905
Sample Code:	PS461905
Equipment used (e.g. laser model and range):	*Mastersizer 2000, hydro mu accessory unit, sieve stack (1mm-16mm in half phi intervals)*
Method used:	NMBAQC PSA SOP for supporting biological data*
Peroxide pre-treatment used:	NO*
Chemical dispersant used:	NO*
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	**63.9848**
-4.00 to -3.50; 11.2 mm	**100.7336**
-3.50 to -3.00; 8 mm	**17.0286**
-3.00 to -2.50; 5.6 mm	**125.2871**
-2.50 to -2.00; 4 mm	**84.1807**
-2.00 to -1.50; 2.8 mm	**19.8903**
-1.50 to -1.00; 2 mm	**22.7728**
-1.00 to -0.50; 1.4 mm	**4.0811**
-0.50 to 0.00; 1 mm	**0.3007**
0.00 to 0.50; (707 µm)	0.0296
0.50 to 1.00; (500 µm)	0.0318
1.00 to 1.50; (353.6 µm)	0.0290
1.50 to 2.00; (250 µm)	0.0278
2.00 to 2.50; (176.8 µm)	0.0321
2.50 to 3.00; (125 µm)	0.0407
3.00 to 3.50; (88.39 µm)	0.0499
3.50 to 4.00; (62.5 µm)	0.0566
4.00 to 4.50; (44.19 µm)	0.0597
4.50 to 5.00; (31.25 µm)	0.0594
5.00 to 5.50; (22.097 µm)	0.0562
5.50 to 6.00; (15.625 µm)	0.0509
6.00 to 6.50; (11.049 µm)	0.0450
6.50 to 7.00; (7.813 µm)	0.0396
7.00 to 7.50; (5.524 µm)	0.0349
7.50 to 8.00; (3.906 µm)	0.0303
8.00 to 8.50; (2.762 µm)	0.0248
8.50 to 9.00; (1.953 µm)	0.0181
9.00 to 9.50; (1.381 µm)	0.0109
9.50 to 10.00; (0.977 µm)	0.0056
10.00 to 10.50; (0.691 µm)	0.0026
10.50 to 11.00; (0.488 µm)	0.0002
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

Exercise Code:	PS46
LabCode:	LB1908
Sample Code:	PS461908
Equipment used (e.g. laser model and range):	Endecotts Test Sieves, Malvern Mastersizer 2000 Laser Diffractor (Model: MAL1002178)
Method used:	Whole sample dry sieved down to <63um, and <63um (Pan) fraction subjected to laser diffraction (based on BS1377: 1990 Parts 1-2 and BS13320: 2009).
Peroxide pre-treatment used:	NO*
Chemical dispersant used:	NO*
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	**12.3825**
-4.00 to -3.50; 11.2 mm	**23.4723**
-3.50 to -3.00; 8 mm	**6.6536**
-3.00 to -2.50; 5.6 mm	**31.6821**
-2.50 to -2.00; 4 mm	**15.9406**
-2.00 to -1.50; 2.8 mm	**3.7673**
-1.50 to -1.00; 2 mm	**5.4189**
-1.00 to -0.50; 1.4 mm	**0.5722**
-0.50 to 0.00; 1 mm	**0.0327**
0.00 to 0.50; (707 µm)	**0.0061**
0.50 to 1.00; (500 µm)	**0.0050**
1.00 to 1.50; (353.6 µm)	**0.0059**
1.50 to 2.00; (250 µm)	**0.0150**
2.00 to 2.50; (176.8 µm)	**0.0120**
2.50 to 3.00; (125 µm)	**0.0111**
3.00 to 3.50; (88.39 µm)	**0.0061**
3.50 to 4.00; (62.5 µm)	**0.0061**
4.00 to 4.50; (44.19 µm)	0.0037
4.50 to 5.00; (31.25 µm)	0.0028
5.00 to 5.50; (22.097 µm)	0.0015
5.50 to 6.00; (15.625 µm)	0.0006
6.00 to 6.50; (11.049 µm)	0.0003
6.50 to 7.00; (7.813 µm)	0.0003
7.00 to 7.50; (5.524 µm)	0.0003
7.50 to 8.00; (3.906 µm)	0.0003
8.00 to 8.50; (2.762 µm)	0.0002
8.50 to 9.00; (1.953 µm)	0.0001
9.00 to 9.50; (1.381 µm)	0.0001
9.50 to 10.00; (0.977 µm)	0.0001
10.00 to 10.50; (0.691 µm)	0.0001
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"
12.50 to 13.00; (0.122 µm)	"0"
13.00 to 13.50; (0.086 µm)	"0"

Exercise Code:	PS46
LabCode:	LB1909
Sample Code:	PS461909
Equipment used (e.g. laser model and range):	*Malvern Mastersizer 2000 (0.01µm to 2000µm)*
Method used:	NMBAQC PSA SOP for supporting biological data*
Peroxide pre-treatment used:	NO*
Chemical dispersant used:	NO*
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	**69.7800**
-4.00 to -3.50; 11.2 mm	**83.2500**
-3.50 to -3.00; 8 mm	**30.7600**
-3.00 to -2.50; 5.6 mm	**126.4100**
-2.50 to -2.00; 4 mm	**88.3000**
-2.00 to -1.50; 2.8 mm	**13.4300**
-1.50 to -1.00; 2 mm	**23.0600**
-1.00 to -0.50; 1.4 mm	**3.9900**
-0.50 to 0.00; 1 mm	**0.2000**
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)	0.0000
1.50 to 2.00; (250 µm)	0.0000
2.00 to 2.50; (176.8 µm)	0.0000
2.50 to 3.00; (125 µm)	0.0000
3.00 to 3.50; (88.39 µm)	0.0000
3.50 to 4.00; (62.5 µm)	0.0000
4.00 to 4.50; (44.19 µm)	0.0000
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)	0.0000
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)	0.0000
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

Exercise Code:	PS46
LabCode:	LB1910
Sample Code:	PS461910
Equipment used (e.g. laser model and range):	*Retsch AS 200 Sieve Shaker*
Method used:	NMBAQC PSA SOP for supporting biological data*
Peroxide pre-treatment used:	NO*
Chemical dispersant used:	NO*
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	**14.7749**
-4.00 to -3.50; 11.2 mm	**21.9939**
-3.50 to -3.00; 8 mm	**4.1704**
-3.00 to -2.50; 5.6 mm	**32.0342**
-2.50 to -2.00; 4 mm	**16.3538**
-2.00 to -1.50; 2.8 mm	**3.8587**
-1.50 to -1.00; 2 mm	**5.0213**
-1.00 to -0.50; 1.4 mm	**1.0284**
-0.50 to 0.00; 1 mm	**0.0865**
0.00 to 0.50; (707 µm)	0.0296
0.50 to 1.00; (500 µm)	0.0432
1.00 to 1.50; (353.6 µm)	0.0728
1.50 to 2.00; (250 µm)	0.1411
2.00 to 2.50; (176.8 µm)	0.1069
2.50 to 3.00; (125 µm)	0.1251
3.00 to 3.50; (88.39 µm)	0.0455
3.50 to 4.00; (62.5 µm)	0.0683
4.00 to 4.50; (44.19 µm)	0.0455
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)	0.0000
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)	0.0000
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

Exercise Code:	PS46
LabCode:	LB1917
Sample Code:	PS461917
Equipment used (e.g. laser model and range):	*Mastersizer with Hydro2000G*
Method used:	NMBAQC PSA SOP for supporting biological data*
Peroxide pre-treatment used:	NO*
Chemical dispersant used:	NO*
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	**70.1400**
-4.00 to -3.50; 11.2 mm	**94.9400**
-3.50 to -3.00; 8 mm	**31.7500**
-3.00 to -2.50; 5.6 mm	**140.3800**
-2.50 to -2.00; 4 mm	**61.9100**
-2.00 to -1.50; 2.8 mm	**14.2800**
-1.50 to -1.00; 2 mm	**22.8500**
-1.00 to -0.50; 1.4 mm	**3.2800**
-0.50 to 0.00; 1 mm	**0.1500**
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)	0.0000
1.50 to 2.00; (250 µm)	0.0000
2.00 to 2.50; (176.8 µm)	0.0000
2.50 to 3.00; (125 µm)	0.0000
3.00 to 3.50; (88.39 µm)	0.0000
3.50 to 4.00; (62.5 µm)	0.0000
4.00 to 4.50; (44.19 µm)	0.0000
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)	0.0000
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)	0.0000
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

Exercise Code:	PS46
LabCode:	LB1921
Sample Code:	PS461921
Equipment used (e.g. laser model and range):	*Malvern Mastersizer 2000 MU*
Method used:	NMBAQC PSA SOP for supporting biological data*
Peroxide pre-treatment used:	NO*
Chemical dispersant used:	NO*
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	**7.7900**
-4.50 to -4.00; 16 mm	**54.8100**
-4.00 to -3.50; 11.2 mm	**96.6100**
-3.50 to -3.00; 8 mm	**27.1000**
-3.00 to -2.50; 5.6 mm	**156.7800**
-2.50 to -2.00; 4 mm	**54.3300**
-2.00 to -1.50; 2.8 mm	**14.1700**
-1.50 to -1.00; 2 mm	**21.6300**
-1.00 to -0.50; 1.4 mm	**38.2000**
-0.50 to 0.00; 1 mm	**0.3500**
0.00 to 0.50; (707 µm)	0.0007
0.50 to 1.00; (500 µm)	0.0115
1.00 to 1.50; (353.6 µm)	0.0218
1.50 to 2.00; (250 µm)	0.0229
2.00 to 2.50; (176.8 µm)	0.0236
2.50 to 3.00; (125 µm)	0.0296
3.00 to 3.50; (88.39 µm)	0.0376
3.50 to 4.00; (62.5 µm)	0.0402
4.00 to 4.50; (44.19 µm)	0.0392
4.50 to 5.00; (31.25 µm)	0.0338
5.00 to 5.50; (22.097 µm)	0.0322
5.50 to 6.00; (15.625 µm)	0.0329
6.00 to 6.50; (11.049 µm)	0.0349
6.50 to 7.00; (7.813 µm)	0.0364
7.00 to 7.50; (5.524 µm)	0.0387
7.50 to 8.00; (3.906 µm)	0.0388
8.00 to 8.50; (2.762 µm)	0.0358
8.50 to 9.00; (1.953 µm)	0.0318
9.00 to 9.50; (1.381 µm)	0.0266
9.50 to 10.00; (0.977 µm)	0.0197
10.00 to 10.50; (0.691 µm)	0.0170
10.50 to 11.00; (0.488 µm)	0.0108
11.00 to 11.50; (0.345 µm)	0.0037
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

Exercise Code:	PS46
LabCode:	LB1955
Sample Code:	PS461955
Equipment used (e.g. laser model and range):	*Coulter LS230 with variable speed fluid module*
Method used:	NMBAQC PSA SOP for supporting biological data*
Peroxide pre-treatment used:	NO*
Chemical dispersant used:	NO*
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	**71.7000**
-4.00 to -3.50; 11.2 mm	**77.3000**
-3.50 to -3.00; 8 mm	**7.9000**
-3.00 to -2.50; 5.6 mm	**31.1000**
-2.50 to -2.00; 4 mm	**1.7000**
-2.00 to -1.50; 2.8 mm	**0.1000**
-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)	0.0097
0.50 to 1.00; (500 µm)	20.4824
1.00 to 1.50; (353.6 µm)	140.1686
1.50 to 2.00; (250 µm)	170.8780
2.00 to 2.50; (176.8 µm)	61.8426
2.50 to 3.00; (125 µm)	8.8291
3.00 to 3.50; (88.39 µm)	2.5097
3.50 to 4.00; (62.5 µm)	0.0000
4.00 to 4.50; (44.19 µm)	0.0000
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)	0.0000
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)	0.0000
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

Exercise Code:	PS46
LabCode:	LB1958
Sample Code:	PS461958
Equipment used (e.g. laser model and range):	
Method used:	NMBAQC PSA SOP for supporting biological data*
Peroxide pre-treatment used:	NO*
Chemical dispersant used:	NO*
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	**39.2900**
-4.50 to -4.00; 16 mm	**30.4100**
-4.00 to -3.50; 11.2 mm	**92.6600**
-3.50 to -3.00; 8 mm	**29.7500**
-3.00 to -2.50; 5.6 mm	**136.8000**
-2.50 to -2.00; 4 mm	**67.8900**
-2.00 to -1.50; 2.8 mm	**17.2400**
-1.50 to -1.00; 2 mm	**21.7900**
-1.00 to -0.50; 1.4 mm	**3.2200**
-0.50 to 0.00; 1 mm	**0.2400**
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)	0.0000
1.50 to 2.00; (250 µm)	0.0000
2.00 to 2.50; (176.8 µm)	0.0000
2.50 to 3.00; (125 µm)	0.0000
3.00 to 3.50; (88.39 µm)	0.0000
3.50 to 4.00; (62.5 µm)	0.0000
4.00 to 4.50; (44.19 µm)	0.0000
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)	0.0000
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)	0.0000
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

Appendix 2. Z-score calculations when data from all participating laboratories are included in mean and standard deviation calculations.

	-6.00 to -5.50	z-score	-5.50 to -5.00	z-score	-5.00 to -4.50	z-score	-4.50 to -4.00	z-score	-4.00 to -3.50	z-score	-3.50 to -3.00	z-score
TUM AVERAGE	0	-0.314918	0	0	0	-0.372641	14.8945	0.593693	21.68975	0.392314	4.668104	-0.450226
LB1901	0	-0.314918	0	0	0	-0.372641	15.87189	0.799915	21.35989	0.340257	4.803704	-0.436998
LB1903	3.770047	3.149183	0	0	0	-0.372641	10.34083	-0.367095	22.26677	0.483377	3.975312	-0.517807
LB1904	0	-0.314918	0	0	0	-0.372641	0	-2.548926	0	-3.03069	40.80642	3.07502
LB1905	0	-0.314918	0	0	0	-0.372641	14.49231	0.508833	22.81576	0.570018	3.856911	-0.529356
LB1908	0	-0.314918	0	0	0	-0.372641	12.38246	0.063674	23.47226	0.673623	6.653647	-0.256538
LB1909	0	-0.314918	0	0	0	-0.372641	15.8887	0.803462	18.95578	-0.039152	7.003962	-0.222366
LB1910	0	-0.314918	0	0	0	-0.372641	14.77487	0.568453	21.99395	0.440322	4.170364	-0.49878
LB1917	0	-0.314918	0	0	0	-0.372641	15.95251	0.816925	21.59298	0.377042	7.221161	-0.201178
LB1921	0	-0.314918	0	0	1.640991	0.262836	11.54592	-0.112831	20.35124	0.181074	5.70871	-0.348716
LB1955	0	-0.314918	0	0	0	-0.372641	14.71547	0.555919	17.34076	-0.294028	11.14599	0.181684
LB1958	0	-0.314918	0	0	8.943978	3.090934	6.922534	-1.088328	21.09313	0.298157	6.772292	-0.244965
Mean	0.342732		0		0.96227		12.08068		19.20386		9.283497	
St. Dev	1.088319		0		2.582296		4.739518		6.336466		10.25129	

	-3.00 to -2.50	z-score	-2.50 to -2.00	z-score	-2.00 to -1.50	z-score	-1.50 to -1.00	z-score	-1.00 to -0.50	z-score	-0.50 to 0.00	z-score
TUM AVERAGE	28.77892	-1.331689	19.93127	1.198029	3.921584	0.871975	4.852762	-0.769393	1.07046	-0.201382	0.103738	1.135524
LB1901	31.02557	0.054926	17.29784	0.188728	3.551672	0.147047	4.583802	-1.787937	1.268194	-0.106717	0.14865	2.512321
LB1903	29.70879	-0.757784	19.70323	1.110628	3.462148	-0.028397	5.056378	0.001698	1.003521	-0.233429	0.072983	0.192709
LB1904	32.79694	1.148197	17.10391	0.114402	3.211542	-0.519517	5.231008	0.663015	0.779523	-0.340667	0.070658	0.121438
LB1905	28.37704	-1.57973	19.0666	0.86663	4.505075	2.01546	5.15795	0.386347	0.924353	-0.27133	0.068107	0.043232
LB1908	31.68207	0.460107	15.94061	-0.331452	3.767301	0.569621	5.418948	1.374739	0.572222	-0.439912	0.032737	-1.041054
LB1909	28.78319	-1.329057	20.10565	1.264863	3.057972	-0.820474	5.250694	0.737569	0.908511	-0.278914	0.045539	-0.648601
LB1910	32.03422	0.677453	16.35383	-0.173078	3.858667	0.748674	5.021273	-0.131246	1.028371	-0.221532	0.086456	0.60572
LB1917	31.92777	0.611752	14.0807	-1.044293	3.247817	-0.448429	5.196961	0.534083	0.745997	-0.356718	0.034116	-0.998801
LB1921	33.02626	1.289732	11.44481	-2.054537	2.98496	-0.963557	4.556435	-1.891573	8.046964	3.138594	0.073729	0.215558
LB1955	29.7994	-0.701859	18.30798	0.575877	2.671353	-1.578144	5.181503	0.475542	0.391491	-0.526436	0.046058	-0.632709
LB1958	31.14116	0.126265	15.45448	-0.517767	3.924515	0.877717	4.960277	-0.362236	0.733001	-0.362939	0.054634	-0.369813
Mean	30.93658		16.80542		3.476638		5.05593		1.491105		0.066697	
St. Dev	1.620241		2.60916		0.510274		0.264063		2.088788		0.032621	

	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	2.50 to 3.00	z-score
TUM AVERAGE	0.011821	-0.325688	0.010732	-0.439492	0.009262	-0.508044	0.008472	-0.507679	0.008516	-0.535717	0.008154	-0.545724
LB1901	0.023767	0.158774	0.016703	-0.220649	0.009358	-0.504915	0.005746	-0.57171	0.00522	-0.632834	0.005518	-0.615591
LB1903	0.05109	1.266875	0.084626	2.266801	0.091307	2.163059	0.081589	1.209647	0.073365	1.374654	0.069319	1.075355
LB1904	0	-0.805094	0	-0.832812	0	-0.809588	0	-0.706663	0	-0.786599	0	-0.761839
LB1905	0.02961	0.395744	0.031823	0.333511	0.029025	0.135379	0.027822	-0.053193	0.032071	0.158186	0.040707	0.317032
LB1908	0.006138	-0.556156	0.005002	-0.649501	0.005911	-0.617149	0.015005	-0.354243	0.012049	-0.431645	0.01114	-0.466597
LB1909	0	-0.805094	0	-0.832812	0	-0.809588	0	-0.706663	0	-0.786599	0	-0.761839
LB1910	0.029577	0.394407	0.043228	0.75153	0.072805	1.560687	0.14106	2.606465	0.106932	2.363499	0.125134	2.554621
LB1917	0	-0.805094	0	-0.832812	0	-0.809588	0	-0.706663	0	-0.786599	0	-0.761839
LB1921	0.000734	-0.775341	0.011495	-0.411518	0.021765	-0.101004	0.022864	-0.169658	0.023558	-0.092611	0.029644	0.023815
LB1955	0.077454	2.336074	0.057076	1.259075	0.043367	0.602295	0.036871	0.159343	0.040523	0.407149	0.034734	0.158721
LB1958	0	-0.805094	0	-0.832812	0	-0.809588	0	-0.706663	0	-0.786599	0	-0.761839
Mean	0.019852		0.022723		0.024867		0.030087		0.026702		0.028745	
St. Dev	0.024658		0.027285		0.030716		0.042576		0.033946		0.037731	

	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
TUM AVERAGE	0.007615	-0.597589	0.005716	-0.65624	0.004522	-0.613233	0.003606	-0.410296	0.002651	-0.410121	0.001959	-0.42125
LB1901	0.005277	-0.699844	0.004377	-0.709639	0.00328	-0.672006	0.002359	-0.478428	0.001703	-0.464597	0.001261	-0.464018
LB1903	0.060644	1.721417	0.044309	0.88286	0.027001	0.450801	0.015275	0.227478	0.009563	-0.012664	0.007031	-0.1105
LB1904	0	-0.930601	0	-0.884216	0	-0.827258	0	-0.607361	0	-0.562535	0	-0.541298
LB1905	0.049949	1.253715	0.056633	1.374347	0.059693	1.998253	0.059367	2.63738	0.056185	2.668167	0.050926	2.578771
LB1908	0.006138	-0.662168	0.006138	-0.639419	0.003661	-0.653956	0.002812	-0.453647	0.001482	-0.477311	0.000574	-0.506126
LB1909	0	-0.930601	0	-0.884216	0	-0.827258	0	-0.607361	0	-0.562535	0	-0.541298
LB1910	0.045503	1.059299	0.068255	1.837818	0.045503	1.326582	0	-0.607361	0	-0.562535	0	-0.541298
LB1917	0	-0.930601	0	-0.884216	0	-0.827258	0	-0.607361	0	-0.562535	0	-0.541298
LB1921	0.037621	0.7146	0.040151	0.717035	0.039172	1.026885	0.03382	1.241072	0.032218	1.290029	0.032872	1.472658
LB1955	0.028949	0.335385	0.024024	0.07386	0.013938	-0.167527	0.008605	-0.137052	0.006462	-0.190953	0.004521	-0.264293
LB1958	0	-0.930601	0	-0.884216	0	-0.827258	0	-0.607361	0	-0.562535	0	-0.541298
Mean	0.02128		0.022172		0.017477		0.011113		0.009783		0.008835	
St. Dev	0.022887		0.025075		0.021127		0.018296		0.017391		0.016322	

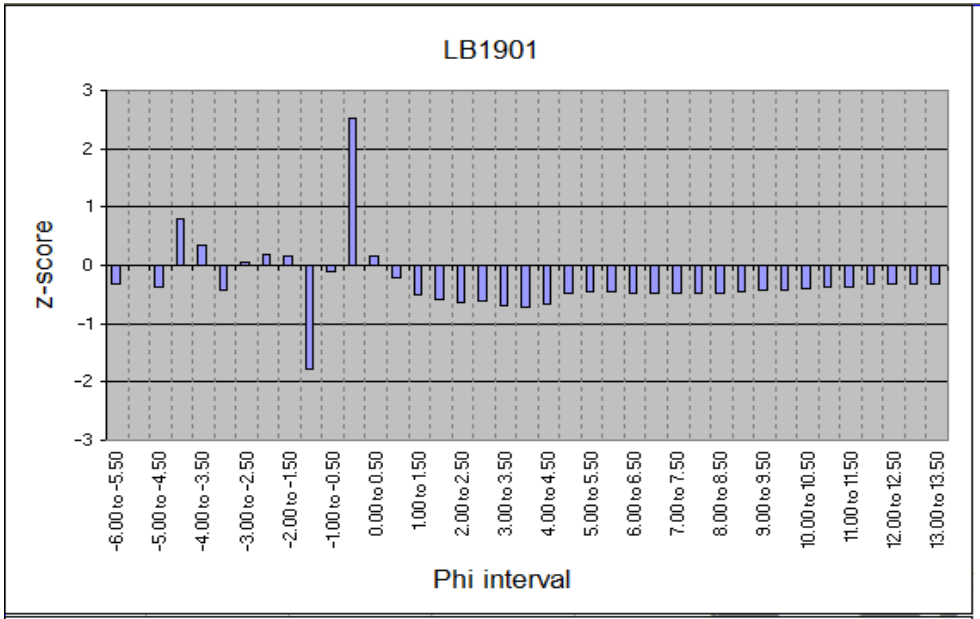
Appendix 2. Z-score calculations when data from all participating laboratories are included in mean and standard deviation calculations.

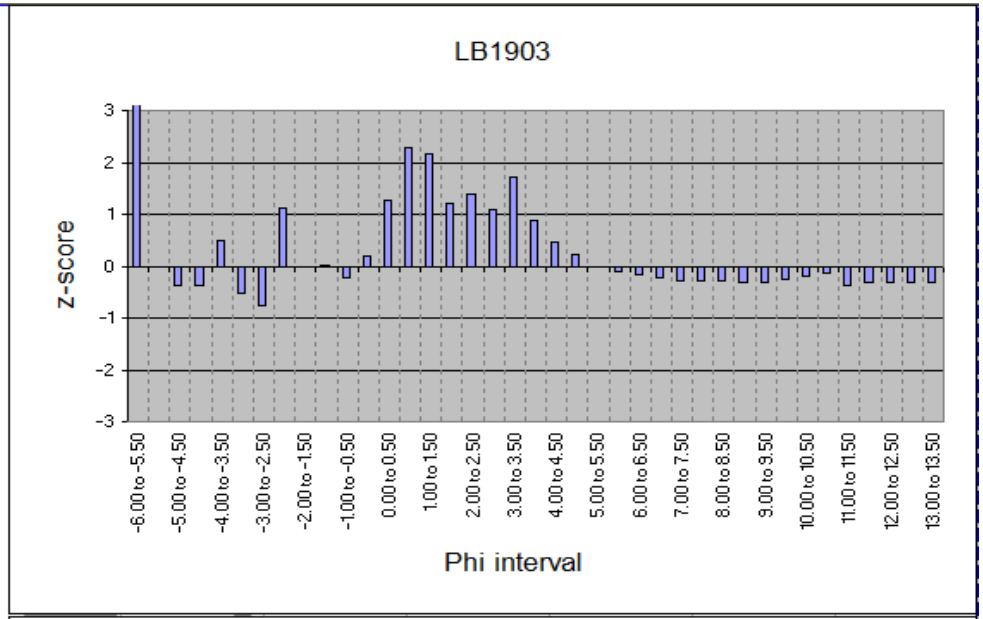
	6.00 to 6.50	z-score	6.50 to 7.00	z-score	7.00 to 7.50	z-score	7.50 to 8.00	z-score	8.00 to 8.50	z-score	8.50 to 9.00	z-score
TUM AVERAGE	0.001548	-0.434128	0.00128	-0.443665	0.001066	-0.449925	0.000875	-0.452197	0.000658	-0.454816	0.000388	-0.455803
LB1901	0.000977	-0.471383	0.000805	-0.476459	0.000701	-0.475957	0.000615	-0.471728	0.000511	-0.467255	0.000377	-0.45695
LB1903	0.005517	-0.175471	0.004349	-0.231689	0.003505	-0.276464	0.002942	-0.296902	0.00251	-0.29808	0.001926	-0.301838
LB1904	0	-0.535054	0	-0.532101	0	-0.52579	0	-0.517959	0	-0.510554	0	-0.494685
LB1905	0.045003	2.3981	0.039565	2.20114	0.034893	1.966379	0.030309	1.759109	0.024839	1.592372	0.018108	1.318874
LB1908	0.000275	-0.517102	0.000288	-0.512319	0.000319	-0.503131	0.000281	-0.496854	0.000202	-0.493453	0.000127	-0.481966
LB1909	0	-0.535054	0	-0.532101	0	-0.52579	0	-0.517959	0	-0.510554	0	-0.494685
LB1910	0	-0.535054	0	-0.532101	0	-0.52579	0	-0.517959	0	-0.510554	0	-0.494685
LB1917	0	-0.535054	0	-0.532101	0	-0.52579	0	-0.517959	0	-0.510554	0	-0.494685
LB1921	0.034934	1.741869	0.036381	1.981145	0.038696	2.226956	0.038758	2.393852	0.035754	2.516422	0.031784	2.688561
LB1955	0.003595	-0.300742	0.003341	-0.301312	0.00319	-0.298831	0.002932	-0.29768	0.00252	-0.297234	0.002011	-0.293259
LB1958	0	-0.535054	0	-0.532101	0	-0.52579	0	-0.517959	0	-0.510554	0	-0.494685
Mean	0.008209		0.007703		0.007391		0.006894		0.006031		0.004939	
St. Dev	0.015343		0.014476		0.014057		0.01331		0.011812		0.009985	

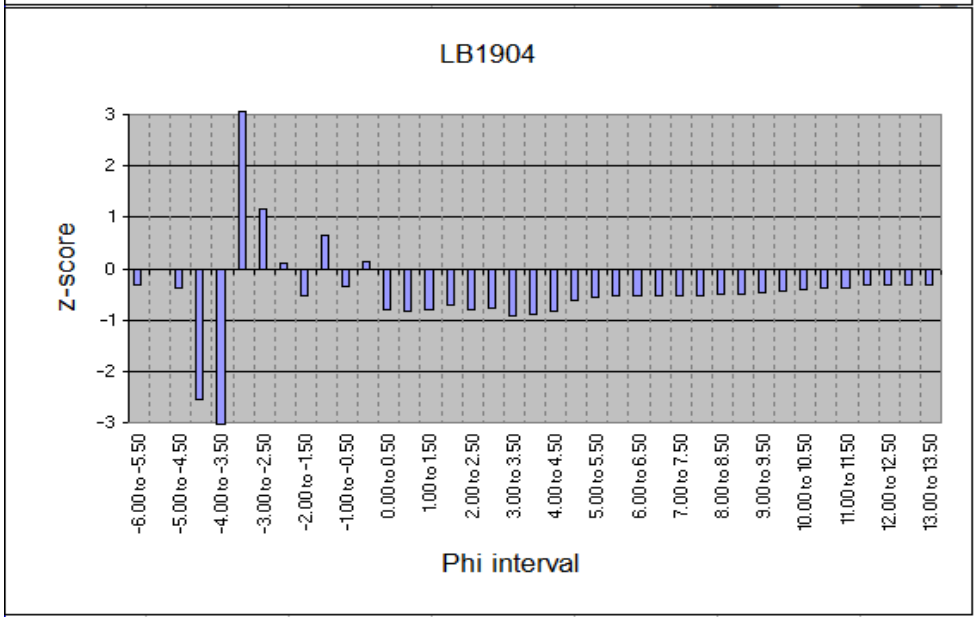
	9.00 to 9.50	z-score	9.50 to 10.00	z-score	10.00 to 10.50	z-score	10.50 to 11.00	z-score	11.00 to 11.50	z-score	11.50 to 12.00	z-score
TUM AVERAGE	6.56E-05	-0.45776	0	-0.438003	0	-0.404905	0	-0.365653	0	-0.362117	0	-0.314918
LB1901	0.000225	-0.43769	0	-0.438003	0	-0.404905	0	-0.365653	0	-0.362117	0	-0.314918
LB1903	0.00132	-0.29981	0.001017	-0.259711	0.00106	-0.186852	0.000735	-0.127067	0	-0.362117	0	-0.314918
LB1904	0	-0.466027	0	-0.438003	0	-0.404905	0	-0.365653	0	-0.362117	0	-0.314918
LB1905	0.010948	0.91283	0.005589	0.541902	0.002642	0.138546	0.000192	-0.303214	0	-0.362117	0	-0.314918
LB1908	8.09E-05	-0.455834	6.6E-05	-0.426437	5.5E-05	-0.393583	8.36E-06	-0.362939	0	-0.362117	0	-0.314918
LB1909	0	-0.466027	0	-0.438003	0	-0.404905	0	-0.365653	0	-0.362117	0	-0.314918
LB1910	0	-0.466027	0	-0.438003	0	-0.404905	0	-0.365653	0	-0.362117	0	-0.314918
LB1917	0	-0.466027	0	-0.438003	0	-0.404905	0	-0.365653	0	-0.362117	0	-0.314918
LB1921	0.026608	2.88516	0.019677	3.012075	0.017036	3.099206	0.010781	3.132764	0.003674	3.110898	0	-0.314918
LB1955	0.001521	-0.27452	0.00113	-0.239811	0.000861	-0.227883	0.000678	-0.145628	0.00054	0.148157	0.000428	3.149183
LB1958	0	-0.466027	0	-0.438003	0	-0.404905	0	-0.365653	0	-0.362117	0	-0.314918
Mean	0.0037		0.002498		0.001969		0.001127		0.000383		3.9E-05	
St. Dev	0.00794		0.005703		0.004862		0.003082		0.001058		0.000124	

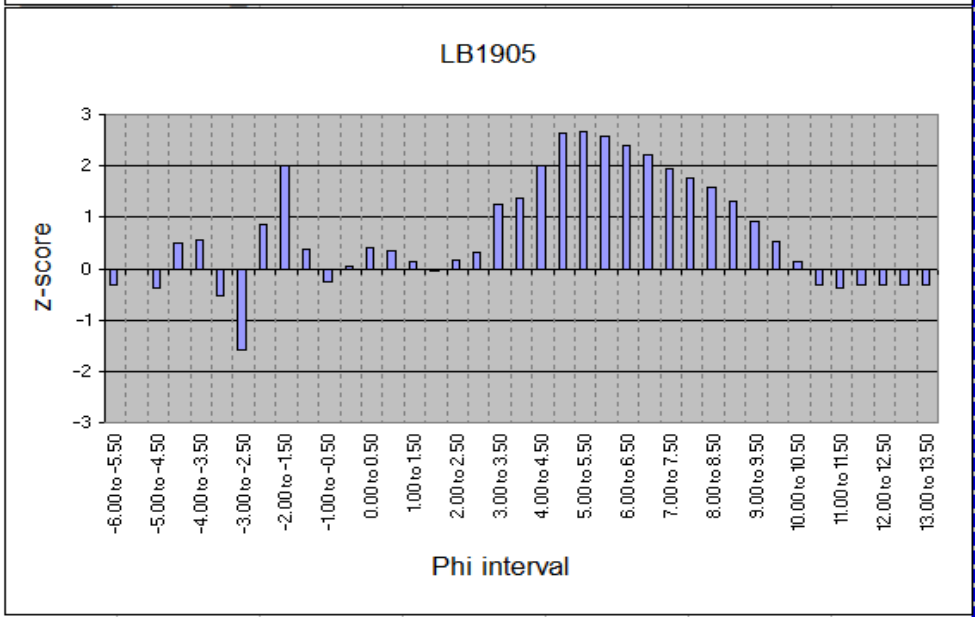
	12.00 to 12.50	z-score	12.50 to 13.00	z-score	13.00 to 13.50	z-score
TUM AVERAGE	0	-0.314918	0	-0.314918	0	-0.314918
LB1901	0	-0.314918	0	-0.314918	0	-0.314918
LB1903	0	-0.314918	0	-0.314918	0	-0.314918
LB1904	0	-0.314918	0	-0.314918	0	-0.314918
LB1905	0	-0.314918	0	-0.314918	0	-0.314918
LB1908	0	-0.314918	0	-0.314918	0	-0.314918
LB1909	0	-0.314918	0	-0.314918	0	-0.314918
LB1910	0	-0.314918	0	-0.314918	0	-0.314918
LB1917	0	-0.314918	0	-0.314918	0	-0.314918
LB1921	0	-0.314918	0	-0.314918	0	-0.314918
LB1955	0.000326	3.149183	0.000245	3.149183	0.000157	3.149183
LB1958	0	-0.314918	0	-0.314918	0	-0.314918
Mean	2.97E-05		2.23E-05		1.43E-05	
St. Dev	9.42E-05		7.07E-05		4.55E-05	

Appendix 3. Summary of z-scores for each half-phi interval for PS46; when data from all participating laboratories included in the mean and standard deviation calculations.

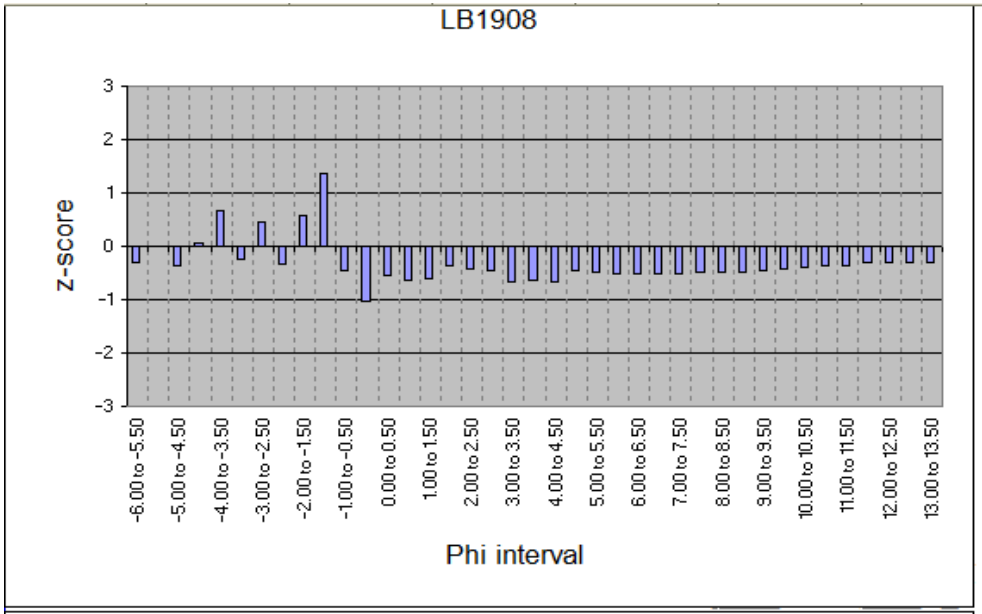


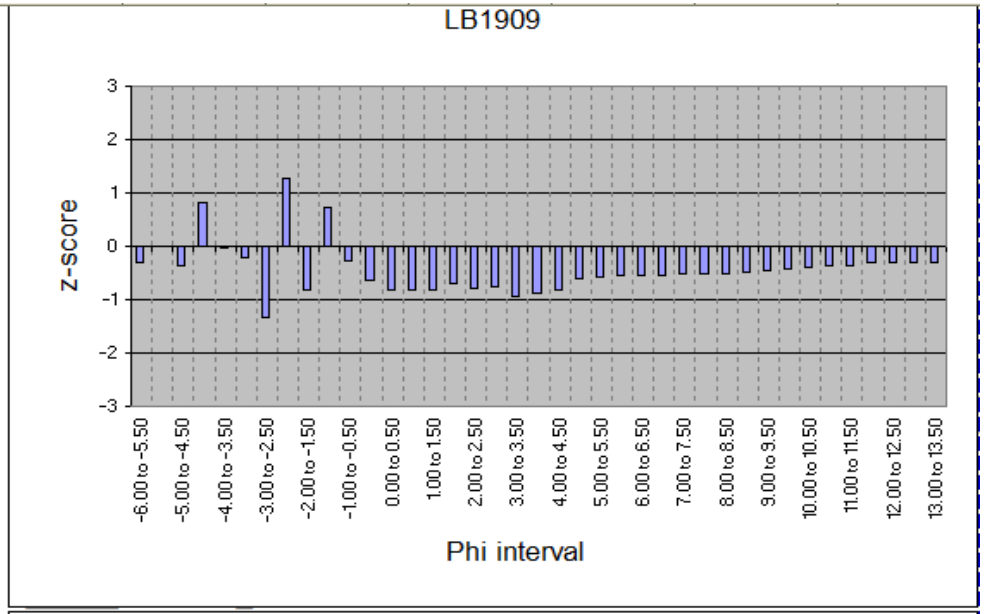


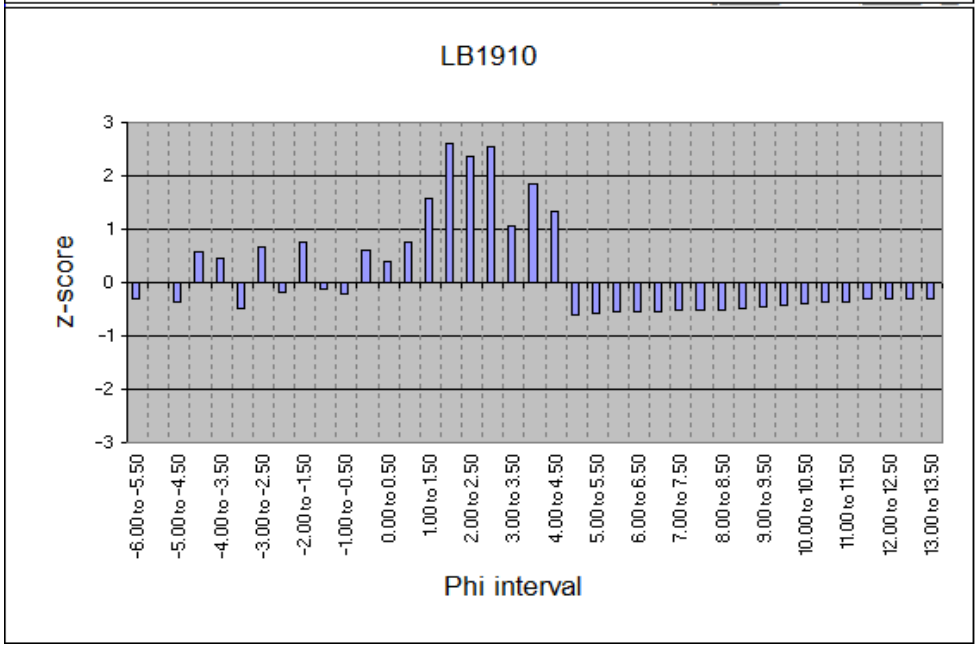


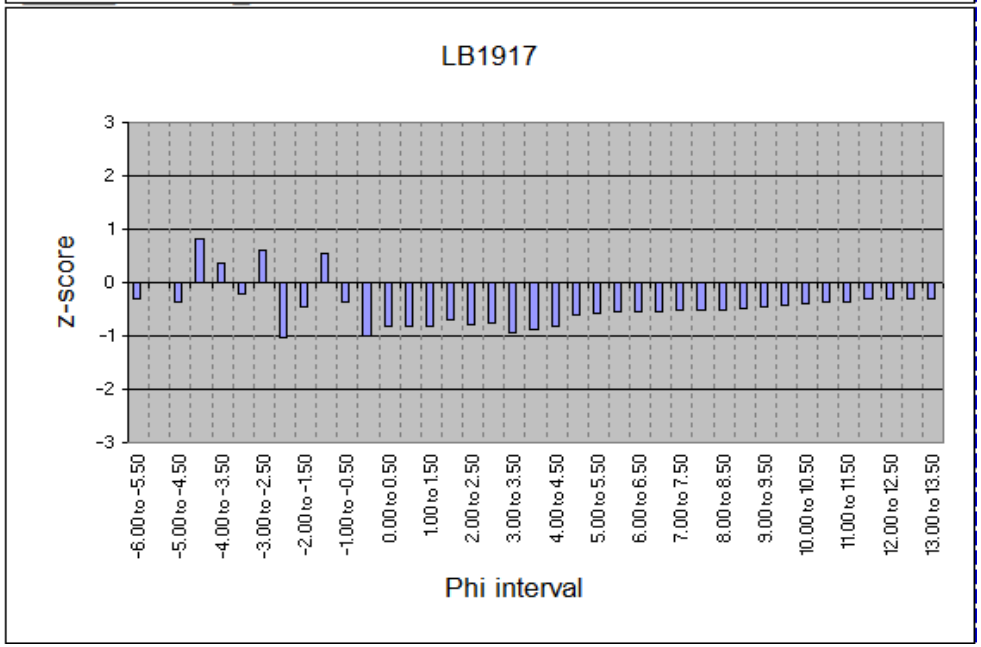


Appendix 3. Summary of z-scores for each half-phi interval for PS46; when data from all participating laboratories included in the mean and standard deviation calculations.









Appendix 3. Summary of z-scores for each half-phi interval for PS46; when data from all participating laboratories included in the mean and standard deviation calculations.