



Ministry of Science,
Technology and Innovation,
Malaysia



APLAC T064 TRACE METALS IN WATER FINAL REPORT

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DEPARTMENT OF CHEMISTRY, MALAYSIA

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SUMMARY

1. The proficiency testing (PT) programme, APLAC T064 was conducted in August 2008.
2. A total of 59 participants from 15 economies had participated and 58 of them had submitted their results.
3. The samples were spiked with nine different trace metal elements at different concentrations. Participants were required to determine and reported the concentration of each element in mg/l up to two decimal places.
4. z-score is used to evaluate the performances of the participants.
5. Results for this PT programme are summarized as follows:

Analyte	Type of sample	Assigned value (mg/l) (Median)	Total number of reported results	Number of laboratories with satisfactory z-scores	% of laboratories with satisfactory z-scores
Aluminium	Sample A	0.29	51	45	88
	Sample B	0.67	52	45	87
Cadmium	Sample A	0.49	57	49	86
	Sample B	0.66	57	51	89
Chromium (total)	Sample A	0.29	58	51	88
	Sample B	0.67	57	49	86
Copper	Sample A	0.97	58	49	84
	Sample B	1.44	58	49	84
Iron	Sample A	0.30	58	49	84
	Sample B	0.76	58	47	81
Manganese	Sample A	0.29	59	49	83
	Sample B	0.47	60	53	88
Lead	Sample A	0.48	57	48	84
	Sample B	0.97	57	49	86
Nickel	Sample A	0.48	58	49	84
	Sample B	0.96	58	50	86
Zinc	Sample A	0.47	58	54	93
	Sample B	0.93	58	54	93

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1. INTRODUCTION

This report summarizes the results of the proficiency testing study for trace metals in water (APLAC T064).

The study was organized by the Department of Standards Malaysia (STANDARDS MALAYSIA) in collaboration with Department of Chemistry, Malaysia (DOC) under the auspices of the Asia Pacific Laboratory Accreditation Cooperation (APLAC).

Accreditation bodies from APLAC as well as other interested bodies were invited to nominate up to three laboratories to participate in this study. Samples were prepared and shipped to 18 accreditation bodies covering 15 economies (59 participants), but only 1 participant failed to submit their result due to instrument breakdown. The list of participating accreditation bodies as well as the participants and their economies is listed in **Appendix 1**.

2. DESIGN AND IMPLEMENTATION

2.1 Sample Preparation

A 100-litre container was filled with 3% nitric acid (HNO_3) and let stand overnight. Each metal element standard was spiked in 3% HNO_3 solution to desired concentration ranging from 0.1 ppm to 2.0 ppm. The sample was then mixed for several hours using motorized stirrer to ensure homogenous solution was obtained. 500 ml of the final solution was dispensed into each polyethylene bottle for dispatch to participants. The bottles were labeled as "APLAC T064, Trace Metals in Water, Sample A" or "Sample B".

2.2 Homogeneity Testing

Ten bottles were randomly selected from each lot, lot A (representing sample A) and lot B (representing sample B) for homogeneity testing. The results obtained were analyzed and the samples were found to be sufficiently homogenous. Please refer to **Appendix 2a** to **2i**.

2.3 Stability Testing

Three randomly selected bottles from lot A and lot B were sent for stability testing after all results had been submitted. After analyzing the results, the samples were found to be statistically stable.

3. FEATURES OF THE SCHEME

3.1 Sample Dispatch and Receipt

Samples were packed into a box for dispatch. Enclosed with the samples were "Instructions to Accreditation Bodies", "Instructions to Participating Laboratories", "Receipt Form" and "Results Sheet". A specimen copy of these documents was given in **Appendices 3** to **6**. Samples were dispatched to participating accreditation bodies in August 2008. The accreditation bodies were responsible to redirect the sample(s) and the attached documents to their nominated participants as soon as possible.

3.2 Method of analysis

Each participant received two bottles of sample labeled as Sample A and Sample B. Participants were required to determine the concentrations of various trace metals in the samples using their routine test methods. The proposed instrumentation techniques were by ICP-MS, ICP-OES, AAS and etc. Most participants quoted using AAS as the instrumentation technique. The list of instrumentation techniques used is available in **Appendix 7**.

3.3 Results

Results were submitted in the Results Sheet accompanying the samples.

4. STATISTICAL ANALYSIS OF RESULTS

Participants' performances were evaluated using the values of z-score. The following information is provided for each sample:

- i) Table of results and the calculated z-scores
- ii) Summary statistics
- iii) Ordered z-score charts

4.1 Table of Results and z-scores

Table 1 to **Table 9** show the results received from each participant, entered according to code numbers. The simple z-scores were calculated for Sample A and Sample B of each participant's results. The results are then assessed based on their z-scores.

4.2 Calculation of z-score

4.2.1 A simple robust z-score (denoted by Z) for a participant's sample (X) was calculated using the following formula:

$$Z = \frac{X - \text{Median}}{\text{Normalised IQR}}$$

The calculated z-score was tabulated alongside the corresponding results in the table of result.

4.2.2 The interpretation of z-score would be:

- (i) $|z| \leq 2$: Satisfactory
- (ii) $2 < |z| < 3$: Questionable
- (iii) $|z| \geq 3$: Not satisfactory

4.2.3 An outlier is defined as any result with an absolute z-score greater than three ($|z| \geq 3$). Outlier result indicates that the result of a participant is far from the consensus value (median).

4.2.4 Participants with z-score greater than three (not satisfactory) are advised to carry out investigation and take necessary corrective action.

4.3 Summary statistics

A summary of the robust statistics at the bottom of table of results include:

- 4.3.1** The number of results received for the sample (No. of results).
- 4.3.2** The median of the results i.e. the middle value (Median).
- 4.3.3** The normalised interquartile range of the results (Normalised IQR) i.e. the interquartile range multiplied by 0.7413, measures the spread of the results. The interquartile range (IQR) is the difference between the upper and lower quartiles.
- 4.3.4** The robust coefficient of variation (Robust CV) i.e. $100 \times \text{Normalised IQR} / \text{Median}$.
- 4.3.5** The maximum and minimum results.
- 4.3.6** The range of results (maximum – minimum).

4.4 Comments on results

- 4.4.1** An interim report was issued on 26 September 2008. A copy of the interim report was emailed to each accreditation body. The accreditation bodies were responsible to redirect the interim report to their participants.
- 4.4.2** Summary below shows participants that obtained outlier results, i.e ($|z| > 3$)

Metals	Laboratory code	
	Sample A	Sample B
Aluminium	530, 566, 581, 588	500, 566, 583, 588
Cadmium	500, 520, 541, 565, 588, 590	500, 520, 583
Chromium	500, 537, 538, 543, 588, 590	500, 520, 537, 540, 583, 590
Copper	537, 538, 540, 588, 590	537, 540, 583, 588, 590
Iron	500, 520, 535, 541, 543, 565, 572, 588, 594	500, 529, 540, 541, 543, 565, 572, 583, 594
Manganese	500, 514, 530, 543, 588, 590	500, 514, 543, 583, 588, 590
Lead	500, 520, 535, 537, 543, 588, 590	500, 520, 535, 537, 566, 583, 590

Metals	Laboratory code	
	Sample A	Sample B
Nickel	520, 535, 565, 588, 590, 594	520, 535, 565, 583, 588, 590, 594
Zinc	500, 520, 543	500, 543

4.5 Ordered z-score charts

Figure 1 to **Figure 18** show the z-scores of each participant, in order of magnitude and marked with respective code number to enable the participants to compare their performance relative to other participants.

Any participants with its “bar” extending beyond +3 and -3 lines are advised to carry out investigation into possible causes of error.

5. REFERENCES

- 5.1 ISO/IEC Guide 43:1997 Proficiency Testing by inter laboratory comparisons
Part 1: Development and operation of proficiency testing schemes
Part 2: Selection and use of proficiency testing schemes by laboratory accreditation bodies
- 5.2 ILAC – G13: 2007 Guidelines for the requirements for the Competence of Providers of Proficiency Testing Schemes
- 5.3 ISO 13528: 2005 Statistical Methods for Use in Proficiency Testing by Interlaboratory Comparisons, Geneva, Switzerland
- 5.4 M. Thompson, S.L Ellison, R. Wood, The International Harmonized Protocol for the Proficiency Testing of (Chemical) Analytical Laboratories (IUPAC Technical Report), *Pure Appl. Chem*, 78: 145-196 (2006)
- 5.5 APLAC PT 002 Testing Interlaboratory Comparisons, Issue No. 5, Issue Date 03/08

Table 1: Reported results and calculated z-scores for Aluminium

Code No.	Aluminium (mg/l)					
	Sample A			Sample B		
	Result	z-score	Uncertainty ($\pm$)	Result	z-score	Uncertainty ($\pm$)
500	ND	-	10.4	0.29	-7.23	10.4
501	0.32	1.35	0.026	0.70	0.67	0.059
503	0.28	-0.45	$x \pm 0.08x$	0.66	-0.10	$x \pm 0.08x$
504	0.31	0.90	NR	0.63	-0.67	NR
505	0.29	0.00	NR	0.57	-1.83	NR
507	0.262	-1.26	0.020	0.597	-1.31	0.043
508	0.28	-0.45	1.4%	0.66	-0.10	1.4%
509	0.31	0.90	0.00072	0.69	0.48	0.00240
510	0.262	-1.26	0.043	0.592	-1.41	0.043
513	0.33	1.80	0.009	0.70	0.67	0.017
514	NR	-	NR	NR	-	NR
516	0.30	0.45	NR	0.69	0.48	NR
519	0.2570	-1.48	0.00008x	0.6035	-1.19	0.00008x
520	0.30	0.45	0.021107363	0.69	0.48	0.021107363
522	0.31	0.90	0.0300	0.72	1.06	0.0300
523	0.31	0.90	NR	0.65	-0.29	NR
525	NR	-	NR	NR	-	NR
526	0.29	0.00	0.03	0.69	0.48	0.03
529	0.25	-1.80	0.04	0.57	-1.83	0.04
530	0.43	6.30	4.0%	0.77	2.02	4.0%
534	0.29	0.00	NR	0.66	-0.10	NR
535	NR	-	NR	NR	-	NR
536	0.26	-1.35	0.02	0.60	-1.25	0.04
537	<0.02	-	NR	<0.02	-	NR
538	NR	-	NR	NR	-	NR
540	0.31	0.90	0.04	0.64	-0.48	0.04
541	0.29	0.00	22%	0.71	0.87	22%
542	NR	-	NR	NR	-	NR
543	NR	-	0.44	NR	-	0.44
547	0.29	0.00	0.01	0.67	0.10	0.01
549	0.29	0.00	0.009	0.67	0.10	0.009
555A	0.28	-0.45	$x \pm 0.03x$	0.65	-0.29	$x \pm 0.03x$
555B	0.32	1.35	$x \pm 0.04x$	0.62	-0.87	$x \pm 0.04x$
555C	NR	-	NR	NR	-	NR
560	0.30	0.45	0.09	0.68	0.29	0.10
561	0.31	0.90	NR	0.67	0.10	NR
563	0.29	0.00	0.08	0.65	-0.29	0.18
565	NR	-	NR	NR	-	NR

Table 1: Reported results and calculated z-scores for Aluminium (cont'd)

Code No.	Aluminium (mg/l)					
	Sample A			Sample B		
	Result	z-score	Uncertainty (±)	Result	z-score	Uncertainty (±)
566	0.38	4.05	5%	0.88	4.14	5%
568	0.27	-0.90	0.051	0.61	-1.06	0.051
571	0.281	-0.40	3.371%	0.650	-0.29	3.371%
572	0.24	-2.25	0.02	0.56	-2.02	0.02
575	0.28	-0.45	0.01	0.67	0.10	0.01
576	0.29	0.00	0.07	0.67	0.10	0.11
578	0.30	0.45	0.026	0.70	0.67	0.026
581	0.39	4.50	0.001	0.73	1.25	0.001
582A	0.30	0.45	0.03	0.68	0.29	0.06
582B	0.33	1.80	0.05	0.71	0.87	0.07
583	0.33	1.80	0.031	0.47	-3.76	0.031
586	0.27	-0.90	0.05	0.62	-0.87	0.05
587	0.28	-0.45	0.032	0.64	-0.48	0.032
588	1.03	33.27	15%	1.18	9.92	15%
590	0.23	-2.70	10%	0.53	-2.60	10%
591	0.30	0.45	11%	0.68	0.29	11%
592	0.27	-0.90	7.85%	0.67	0.10	7.85%
593	0.28	-0.45	0.01	0.67	0.10	0.02
594	0.30	0.45	0.03	0.62	-0.87	0.03
596	0.29	0.00	0.02	0.65	-0.29	0.04
597	0.29	0.00	0.040	0.65	-0.29	0.089
598	0.30	0.45	0.02	0.71	0.87	0.02
599	0.31	0.90	NR	0.70	0.67	NR
No.of results	51			52		
Median	0.29			0.67		
Normalised IQR	0.02			0.05		
Robust CV	7.7			7.8		
Maximum	1.03			1.18		
Minimum	0.23			0.29		
Range	0.80			0.89		

* Note: NR = Not Reported, ND = Not Detected

z-scores outside the satisfactory range, i.e. $|z| \geq 3$, are shown in **bold**

Table 2: Reported results and calculated z-scores for Cadmium

Code No.	Cadmium (mg/l)					
	Sample A			Sample B		
	Result	z-score	Uncertainty ($\pm$)	Result	z-score	Uncertainty ($\pm$)
500	0.34	-5.06	1.59	0.49	-3.28	1.59
501	0.51	0.67	0.058	0.69	0.58	0.079
503	0.48	-0.34	$x \pm 0.06x$	0.67	0.19	$x \pm 0.06x$
504	0.55	2.02	NR	0.60	-1.16	NR
505	0.48	-0.34	NR	0.63	-0.58	NR
507	0.457	-1.11	0.033	0.616	-0.85	0.044
508	0.47	-0.67	2.8%	0.65	-0.19	2.8%
509	0.50	0.34	0.00055	0.68	0.39	0.00440
510	0.513	0.78	0.002	0.694	0.66	0.002
513	NR	-	NR	NR	-	NR
514	NR	-	NR	NR	-	NR
516	0.51	0.67	NR	0.71	0.96	NR
519	0.4493	-1.37	0.00080x	0.6253	-0.67	0.00080x
520	0.84	11.80	0.10684854	0.97	5.97	0.10684854
522	0.47	-0.67	0.0065	0.65	-0.19	0.0065
523	0.52	1.01	NR	0.62	-0.77	NR
525	NR	-	NR	NR	-	NR
526	0.51	0.67	0.03	0.70	0.77	0.03
529	0.45	-1.35	0.002	0.61	-0.96	0.002
530	0.50	0.34	1.0%	0.68	0.39	1.0%
534	0.48	-0.34	NR	0.67	0.19	NR
535	0.46	-1.01	0.03Cd	0.64	-0.39	0.03Cd
536	0.47	-0.67	0.06	0.63	-0.58	0.08
537	0.50	0.34	NR	0.69	0.58	NR
538	0.49	0.00	0.69	0.71	0.96	0.71
540	NR	-	NR	NR	-	NR
541	0.59	3.37	22%	0.80	2.70	22%
542	0.53	1.35	0.01	0.69	0.58	0.01
543	0.44	-1.69	0.32	0.59	-1.35	0.32
547	0.48	-0.34	0.01	0.66	0.00	0.01
549	0.47	-0.67	0.004	0.65	-0.19	0.004
555A	0.49	0.00	$x \pm 0.06x$	0.68	0.39	$x \pm 0.06x$
555B	0.48	-0.34	$x \pm 0.02x$	0.72	1.16	$x \pm 0.02x$
555C	0.50	0.34	$x \pm 0.06x$	0.68	0.39	$x \pm 0.06x$
560	0.46	-1.01	0.11	0.64	-0.39	0.16
561	0.49	0.00	NR	0.65	-0.19	NR
563	0.46	-1.01	0.07	0.64	-0.39	0.10
565	0.40	-3.04	5%	0.55	-2.12	5%
566	0.47	-0.67	5%	0.65	-0.19	5%
568	0.44	-1.69	0.020	0.60	-1.16	0.020
571	0.492	0.07	3.953%	0.672	0.23	3.953%
572	0.44	-1.69	0.03	0.62	-0.77	0.03

Table 2: Reported results and calculated z-scores for Cadmium (cont'd)

Code No.	Cadmium (mg/l)					
	Sample A			Sample B		
	Result	z-score	Uncertainty (±)	Result	z-score	Uncertainty (±)
575	0.43	-2.02	0.04	0.61	-0.96	0.04
576	0.49	0.00	0.12	0.68	0.39	0.10
578	0.50	0.34	0.019	0.68	0.39	0.019
581	0.48	-0.34	0.003	0.66	0.00	0.003
582A	0.50	0.34	0.03	0.69	0.58	0.04
582B	0.51	0.67	0.05	0.70	0.77	0.07
583	0.50	0.34	0.032	0.49	-3.28	0.032
586	0.50	0.34	NR	0.68	0.39	NR
587	0.5	0.34	0.057	0.67	0.19	0.057
588	0.40	-3.04	15%	0.56	-1.93	15%
590	0.40	-3.04	10%	0.55	-2.12	10%
591	0.51	0.67	3%	0.70	0.77	3%
592	0.51	0.67	1.09%	0.70	0.77	1.09%
593	0.50	0.34	0.02	0.68	0.39	0.03
594	0.46	-1.01	0.02	0.64	-0.39	0.02
596	0.45	-1.35	0.036	0.62	-0.77	0.049
597	0.47	-0.67	0.050	0.62	-0.77	0.065
598	0.49	0.00	0.02	0.69	0.58	0.02
599	0.49	0.00	NR	0.66	0.00	NR
No.of results	57			57		
Median	0.49			0.66		
Normalised IQR	0.03			0.05		
Robust CV	6.1			7.9		
Maximum	0.84			0.97		
Minimum	0.34			0.49		
Range	0.50			0.48		

* Note: NR = Not Reported

z-scores outside the satisfactory range, i.e. $|z| \geq 3$, are shown in **bold**

Table 3: Reported results and calculated z-scores for Chromium (total)

Code No.	Chromium (total) (mg/l)					
	Sample A			Sample B		
	Result	z-score	Uncertainty ($\pm$)	Result	z-score	Uncertainty ($\pm$)
500	0.19	-4.50	7.05	0.55	-3.24	7.05
501	0.29	0.00	0.033	0.67	0.00	0.076
503	0.31	0.90	$x \pm 0.05x$	0.70	0.81	$x \pm 0.05x$
504	0.29	0.00	NR	0.69	0.54	NR
505	0.26	-1.35	NR	0.59	-2.16	NR
507	0.317	1.21	0.023	0.664	-0.16	0.047
508	0.29	0.00	0.5%	0.65	-0.54	0.5%
509	0.31	0.90	0.00211	0.69	0.54	0.00274
510	0.283	-0.31	0.039	0.648	-0.59	0.039
513	NR	-	NR	NR	-	NR
514	NR	-	NR	NR	-	NR
516	0.30	0.45	NR	0.68	0.27	NR
519	0.2782	-0.53	0.00089x	0.6293	-1.10	0.00089x
520	0.29	0.00	0.015475746	0.41	-7.01	0.015475746
522	0.30	0.45	0.0078	0.68	0.27	0.0078
523	0.30	0.45	NR	0.69	0.54	NR
525	NR	-	NR	NR	-	NR
526	0.30	0.45	0.03	0.68	0.27	0.03
529	0.29	0.00	0.05	0.65	-0.54	0.05
530	0.27	-0.90	1.0%	0.56	-2.97	1.0%
534	0.30	0.45	NR	0.65	-0.54	NR
535	0.29	0.00	NR	0.64	-0.81	NR
536	0.31	0.90	0.04	0.68	0.27	0.09
537	0.40	4.95	NR	1.04	9.98	NR
538	0.37	3.60	0.95	0.67	0.00	0.28
540	0.24	-2.25	0.01	0.53	-3.78	0.01
541	0.32	1.35	22%	0.74	1.89	22%
542	0.30	0.45	0.01	0.65	-0.54	0.01
543	0.36	3.15	0.22	0.69	0.54	0.22
547	0.29	0.00	0.01	0.66	-0.27	0.02
549	0.29	0.00	0.012	0.66	-0.27	0.012
555A	0.31	0.90	$x \pm 0.04x$	0.69	0.54	$x \pm 0.04x$
555B	0.28	-0.45	$x \pm 0.09x$	0.71	1.08	$x \pm 0.09x$
555C	0.31	0.90	$x \pm 0.12x$	0.69	0.54	$x \pm 0.12x$
560	0.27	-0.90	0.05	0.64	-0.81	0.13
561	0.28	-0.45	NR	0.67	0.00	NR
563	0.28	-0.45	0.03	0.65	-0.54	0.07
565	0.28	-0.45	5%	0.64	-0.81	5%
566	0.32	1.35	5%	0.64	-0.81	5%
568	0.27	-0.90	0.067	0.61	-1.62	0.067
571	0.299	0.40	3.836%	0.683	0.35	3.836%
572	0.28	-0.45	0.02	0.64	-0.81	0.02

Table 3: Reported results and calculated z-scores for Chromium (total) (cont'd)

Code No.	Chromium (total) (mg/l)					
	Sample A			Sample B		
	Result	z-score	Uncertainty (±)	Result	z-score	Uncertainty (±)
575	0.28	-0.45	0.03	0.65	-0.54	0.03
576	0.29	0.00	0.06	0.68	0.27	0.10
578	0.29	0.00	0.013	0.67	0.00	0.013
581	0.30	0.45	0.003	0.70	0.81	0.005
582A	0.30	0.45	0.02	0.68	0.27	0.03
582B	0.32	1.35	0.02	0.72	1.35	0.03
583	0.33	1.80	0.034	0.33	-9.17	0.034
586	0.30	0.45	0.03	0.67	0.00	0.03
587	0.30	0.45	0.034	0.68	0.27	0.034
588	0.60	13.94	15%	NR	-	15%
590	0.22	-3.15	10%	0.50	-4.59	10%
591	0.31	0.90	3%	0.69	0.54	3%
592	0.30	0.45	2.17%	0.68	0.27	2.17%
593	0.29	0.00	0.01	0.68	0.27	0.02
594	0.25	-1.80	0.02	0.66	-0.27	0.02
596	0.32	1.35	0.048	0.72	1.35	0.110
597	0.27	-0.90	0.027	0.61	-1.62	0.050
598	0.29	0.00	0.01	0.69	0.54	0.01
599	0.29	0.00	NR	0.67	0.00	NR
No.of results	58			57		
Median	0.29			0.67		
Normalised IQR	0.02			0.04		
Robust CV	7.7			5.5		
Maximum	0.60			1.04		
Minimum	0.19			0.33		
Range	0.41			0.71		

* Note: NR = Not Reported

z-scores outside the satisfactory range, i.e. $|z| \geq 3$, are shown in **bold**

Table 4: Reported results and calculated z-scores for Copper

Code No.	Copper (mg/l)					
	Sample A			Sample B		
	Result	z-score	Uncertainty ($\pm$)	Result	z-score	Uncertainty ($\pm$)
500	1.00	0.85	3.64	1.42	-0.36	3.64
501	0.95	-0.57	0.06	1.4	-0.72	0.09
503	1.01	1.14	$x \pm 0.08x$	1.49	0.90	$x \pm 0.08x$
504	0.97	0.00	NR	1.41	-0.54	NR
505	1.00	0.85	NR	1.43	-0.18	NR
507	0.884	-2.44	0.062	1.280	-2.87	0.091
508	0.95	-0.57	0.5%	1.44	0.00	0.5%
509	0.99	0.57	0.00618	1.43	-0.18	0.00512
510	0.961	-0.26	0.043	1.45	0.18	0.043
513	NR	-	NR	NR	-	NR
514	NR	-	NR	NR	-	NR
516	0.98	0.28	NR	1.5	1.08	NR
519	0.9731	0.09	0.00119x	1.4662	0.47	0.00119x
520	0.98	0.28	0.027705654	1.44	0.00	0.027705654
522	1.05	2.27	0.0195	1.56	2.15	0.0195
523	0.98	0.28	NR	1.49	0.90	NR
525	NR	-	NR	NR	-	NR
526	0.99	0.57	0.06	1.46	0.36	0.06
529	0.90	-1.99	0.06	1.36	-1.43	0.06
530	0.96	-0.28	1.0%	1.40	-0.72	1.0%
534	0.92	-1.42	NR	1.37	-1.25	NR
535	0.92	-1.42	NR	1.39	-0.90	NR
536	0.99	0.57	0.02	1.45	0.18	0.03
537	0.85	-3.41	NR	1.25	-3.41	NR
538	0.57	-11.36	0.58	1.48	0.72	0.26
540	0.74	-6.53	0.02	1.10	-6.10	0.02
541	1.00	0.85	22%	1.50	1.08	22%
542	0.96	-0.28	0.01	1.43	-0.18	0.01
543	0.92	-1.42	0.42	1.33	-1.97	0.42
547	0.96	-0.28	0.02	1.42	-0.36	0.002
549	0.94	-0.85	0.022	1.40	-0.72	0.022
555A	1.01	1.14	$x \pm 0.03x$	1.51	1.25	$x \pm 0.03x$
555B	0.96	-0.28	$x \pm 0.1x$	1.50	1.08	$x \pm 0.1x$
555C	0.97	0.00	$x \pm 0.2x$	1.46	0.36	$x \pm 0.2x$
560	0.98	0.28	0.20	1.45	0.18	0.29
561	0.94	-0.85	NR	1.48	0.72	NR
563	0.93	-1.14	0.10	1.37	-1.25	0.15
565	0.88	-2.56	2.1%	1.31	-2.33	2.1%

Table 4: Reported results and calculated z-scores for Copper (cont'd)

Code No.	Copper (mg/l)					
	Sample A			Sample B		
	Result	z-score	Uncertainty (±)	Result	z-score	Uncertainty (±)
566	1.01	1.14	3%	1.48	0.72	3%
568	0.96	-0.28	0.026	1.41	-0.54	0.026
571	0.984	0.40	4.962%	1.477	0.66	4.962%
572	0.91	-1.70	0.05	1.32	-2.15	0.05
575	0.97	0.00	0.08	1.47	0.54	0.08
576	0.95	-0.57	0.15	1.41	-0.54	0.22
578	0.98	0.28	0.036	1.45	0.18	0.036
581	0.98	0.28	0.001	1.48	0.72	0.002
582A	0.98	0.28	0.05	1.46	0.36	0.07
582B	1.01	1.14	0.04	1.51	1.25	0.06
583	1.06	2.56	0.032	1.05	-6.99	0.032
586	0.93	-1.14	0.03	1.4	-0.72	0.10
587	0.97	0.00	0.11	1.42	-0.36	0.11
588	0.71	-7.38	15%	1.14	-5.38	15%
590	0.74	-6.53	10%	1.1	-6.10	10%
591	1.02	1.42	4%	1.54	1.79	4%
592	0.95	-0.57	1.47%	1.44	0.00	1.47%
593	0.97	0.00	0.02	1.46	0.36	0.03
594	0.93	-1.14	0.02	1.43	-0.18	0.02
596	0.98	0.28	0.075	1.44	0.00	0.11
597	0.96	-0.28	0.006	1.40	-0.72	0.009
598	0.97	0.00	0.01	1.49	0.90	0.04
599	0.98	0.28	2.20%	1.44	0.00	2.20%
No.of results	58			58		
Median	0.97			1.44		
Normalised IQR	0.04			0.06		
Robust CV	3.6			3.9		
Maximum	1.06			1.56		
Minimum	0.57			1.05		
Range	0.49			0.51		

* Note: NR = Not Reported

z-scores outside the satisfactory range, i.e. $|z| \geq 3$, are shown in **bold**

Table 5: Reported results and calculated z-scores for Iron

Code No.	Iron (mg/l)					
	Sample A			Sample B		
	Result	z-score	Uncertainty ($\pm$)	Result	z-score	Uncertainty ($\pm$)
500	0.23	-3.15	5.10	0.57	-5.21	5.10
501	0.31	0.45	0.02	0.78	0.46	0.05
503	0.27	-1.35	$x \pm 0.06x$	0.73	-0.89	$x \pm 0.06x$
504	0.31	0.45	NR	0.75	-0.35	NR
505	0.30	0.00	NR	0.73	-0.89	NR
507	0.332	1.44	0.024	0.775	0.32	0.055
508	0.29	-0.45	5.4%	0.73	-0.89	5.4%
509	0.31	0.45	0.00257	0.75	-0.35	0.00489
510	0.293	-0.31	0.040	0.730	-0.89	0.040
513	NR	-	NR	NR	-	NR
514	NR	-	95%	NR	-	95%
516	0.30	0.00	NR	0.77	0.19	NR
519	0.2779	-0.99	0.00025x	0.7050	-1.56	0.00025x
520	0.17	-5.85	0.047312596	0.79	0.73	0.047312596
522	0.31	0.45	0.0117	0.78	0.46	0.0117
523	0.30	0.00	NR	0.75	-0.35	NR
525	Under range	-	NR	Under range	-	NR
526	0.32	0.90	0.03	0.78	0.46	0.03
529	0.29	-0.45	0.06	0.92	4.24	0.06
530	0.29	-0.45	1.0%	0.72	-1.16	1.0%
534	0.30	0.00	NR	0.76	-0.08	NR
535	0.42	5.40	NR	0.82	1.54	NR
536	0.30	0.00	0.03	0.74	-0.62	0.07
537	0.28	-0.90	NR	0.75	-0.35	NR
538	0.28	-0.90	1.18	0.86	2.62	0.14
540	0.28	-0.90	0.02	0.62	-3.86	0.02
541	0.18	-5.40	22%	0.94	4.78	22%
542	0.30	0.00	0.01	0.80	1.00	0.01
543	0.19	-4.95	0.32	1.00	6.39	0.32
547	0.29	-0.45	0.01	0.75	-0.35	0.01
549	0.29	-0.45	0.016	0.74	-0.62	0.016
555A	0.32	0.90	$x \pm 0.05x$	0.81	1.27	$x \pm 0.05x$
555B	0.30	0.00	$x \pm 0.04x$	0.80	1.00	$x \pm 0.04x$
555C	0.32	0.90	$x \pm 0.09x$	0.78	0.46	$x \pm 0.09x$
560	0.27	-1.35	0.07	0.70	-1.70	0.10
561	0.34	1.80	NR	0.78	0.46	NR
563	0.29	-0.45	0.06	0.72	-1.16	0.14
565	0.12	-8.09	3.1%	0.59	-4.67	3.1%
566	0.32	0.90	5%	0.86	2.62	5%
568	0.32	0.90	0.026	0.76	-0.08	0.026
571	0.300	0.00	4.722%	0.766	0.08	4.722%
572	0.17	-5.85	0.02	0.59	-4.67	0.02

Table 5: Reported results and calculated z-scores for Iron (cont'd)

Code No.	Iron (mg/l)					
	Sample A			Sample B		
	Result	z-score	Uncertainty (±)	Result	z-score	Uncertainty (±)
575	0.27	-1.35	0.03	0.72	-1.16	0.03
576	0.30	0.00	0.07	0.78	0.46	0.12
578	0.30	0.00	0.020	0.77	0.19	0.020
581	0.31	0.45	0.001	0.78	0.46	0.001
582A	0.31	0.45	0.03	0.80	1.00	0.06
582B	0.30	0.00	0.02	0.79	0.73	0.04
583	0.33	1.35	0.033	0.64	-3.32	0.033
586	0.30	0.00	0.04	0.75	-0.35	0.04
587	0.32	0.90	0.037	0.78	0.46	0.037
588	0.21	-4.05	15%	0.72	-1.16	15%
590	0.28	-0.90	10%	0.71	-1.43	10%
591	0.31	0.45	8%	0.77	0.19	8%
592	0.30	0.00	2.84%	0.76	-0.08	2.84%
593	0.29	-0.45	0.01	0.77	0.19	0.03
594	0.18	-5.40	0.02	0.64	-3.32	0.02
596	0.32	0.90	NR	0.77	0.19	NR
597	0.28	-0.90	0.042	0.70	-1.70	0.100
598	0.31	0.45	0.01	0.79	0.73	0.02
599	0.31	0.45	2.60%	0.78	0.46	2.60%
No.of results	58			58		
Median	0.30			0.76		
Normalised IQR	0.02			0.04		
Robust CV	7.4			4.9		
Maximum	0.42			1.00		
Minimum	0.12			0.57		
Range	0.30			0.43		

* Note: NR = Not Reported

z-scores outside the satisfactory range, i.e. $|z| \geq 3$, are shown in **bold**

Table 6: Reported results and calculated z-scores for Manganese

Code No.	Manganese (mg/l)					
	Sample A			Sample B		
	Result	z-score	Uncertainty ($\pm$)	Result	z-score	Uncertainty ($\pm$)
500	0.39	7.10	6.67	0.56	3.04	6.67
501	0.30	0.71	0.020	0.47	0.00	0.032
503	0.28	-0.71	$x \pm 0.06x$	0.45	-0.67	$x \pm 0.06x$
504	0.29	0.00	NR	0.46	-0.34	NR
505	0.30	0.71	NR	0.47	0.00	NR
507	0.282	-0.57	0.020	0.445	-0.84	0.032
508	0.29	0.00	4.9%	0.45	-0.67	4.9%
509	0.30	0.71	0.00133	0.47	0.00	0.00240
510	0.286	-0.28	0.038	0.458	-0.40	0.038
513	0.29	0.00	0.008	0.48	0.34	0.013
514	0.0071	-20.09	95.8%	0.0106	-15.49	95.8%
516	0.305	1.06	NR	0.497	0.91	NR
519	0.2779	-0.86	0.00020x	0.4153	-1.84	0.00020x
520	0.29	0.00	0.008376155	0.46	-0.34	0.008376155
522	0.29	0.00	0.0358	0.48	0.34	0.0358
523	0.29	0.00	NR	0.51	1.35	NR
525	Under range	-	NR	0.44	-1.01	NR
526	0.31	1.42	0.02	0.49	0.67	0.02
529	0.29	0.00	0.002	0.46	-0.34	0.002
530	0.35	4.26	1.0%	0.54	2.36	1.0%
534	0.30	0.71	NR	0.47	0.00	NR
535	0.27	-1.42	NR	0.45	-0.67	NR
536	0.28	-0.71	0.01	0.49	0.67	0.02
537	0.26	-2.13	NR	0.42	-1.69	NR
538	0.28	-0.71	0.15	0.48	0.34	0.09
540	NR	-	NR	NR	-	NR
541	0.32	2.13	22%	0.52	1.69	22%
542	0.30	0.71	0.01	0.45	-0.67	0.01
543	0.06	-16.33	0.88	0.26	-7.08	0.88
547	0.29	0.00	0.01	0.47	0.00	0.01
549	0.29	0.00	0.009	0.46	-0.34	0.009
555A	0.31	1.42	$x \pm 0.06x$	0.50	1.01	$x \pm 0.06x$
555B	0.31	1.42	$x \pm 0.05x$	0.52	1.69	$x \pm 0.05x$
555C	0.29	0.00	$x \pm 0.08x$	0.46	-0.34	$x \pm 0.08x$
560	0.27	-1.42	0.05	0.45	-0.67	0.09
561	0.28	-0.71	NR	0.47	0.00	NR
563	0.29	0.00	0.07	0.45	-0.67	0.1
565	0.26	-2.13	5.0%	0.45	-0.67	5.0%
566	0.29	0.00	5%	0.46	-0.34	5%
568	0.29	0.00	0.02	0.46	-0.34	0.02
571	0.301	0.78	3.647	0.484	0.47	3.647
572	0.27	-1.42	0.02	0.44	-1.01	0.02

Table 6: Reported results and calculated z-scores for Manganese (cont'd)

Code No.	Manganese (mg/l)					
	Sample A			Sample B		
	Result	z-score	Uncertainty (±)	Result	z-score	Uncertainty (±)
575	0.29	0.00	0.03	0.45	-0.67	0.03
576	0.30	0.71	0.07	0.48	0.34	0.09
578	0.30	0.71	0.014	0.48	0.34	0.014
581	0.30	0.71	0.002	0.49	0.67	0.002
582A	0.31	1.42	0.02	0.49	0.67	0.03
582B	0.31	1.42	0.01	0.50	1.01	0.02
583	0.30	0.71	0.033	0.38	-3.04	0.033
586	0.30	0.71	0.04	0.48	0.34	0.04
587	0.31	1.42	0.036	0.50	1.01	0.036
588	1.26	68.87	15%	1.27	26.98	15%
590	0.23	-4.26	10%	0.37	-3.37	10%
591	0.31	1.42	6%	0.49	0.67	6%
592	0.30	0.71	1.51%	0.48	0.34	1.51%
593	0.30	0.71	0.01	0.48	0.34	0.01
594	0.26	-2.13	0.024	0.42	-1.69	0.024
596	0.29	0.00	NR	0.47	0.00	NR
597	0.27	-1.42	0.029	0.44	-1.01	0.047
598	0.30	0.71	0.02	0.50	1.01	0.02
599	0.30	0.71	NR	0.47	0.00	NR
No.of results	59			60		
Median	0.29			0.47		
Normalised IQR	0.01			0.03		
Robust CV	4.9			6.3		
Maximum	1.26			1.27		
Minimum	0.01			0.01		
Range	1.25			1.26		

* Note: NR = Not Reported

z-scores outside the satisfactory range, i.e. $|z| \geq 3$, are shown in **bold**

Table 7: Reported results and calculated z-scores for Lead

Code No.	Lead (mg/l)					
	Sample A			Sample B		
	Result	z-score	Uncertainty ($\pm$)	Result	z-score	Uncertainty ($\pm$)
500	0.23	-11.24	1.10	0.65	-7.19	1.10
501	0.48	0.00	0.036	0.95	-0.45	0.072
503	0.47	-0.45	$x \pm 0.08x$	0.94	-0.67	$x \pm 0.08x$
504	0.49	0.45	NR	1.00	0.67	NR
505	0.47	-0.45	NR	0.96	-0.22	NR
507	0.447	-1.48	0.036	0.899	-1.60	0.064
508	0.47	-0.45	5.3%	0.94	-0.67	5.3%
509	0.50	0.90	0.00250	0.98	0.22	0.01440
510	0.446	-1.53	0.048	0.881	-2.00	0.048
513	NR	-	NR	NR	-	NR
514	NR	-	NR	NR	-	NR
516	0.48	0.00	NR	0.97	0.00	NR
519	0.4492	-1.38	0.00086x	0.9105	-1.34	0.00086x
520	1.79	58.91	0.265662282	3.62	59.58	0.265662282
522	0.49	0.45	0.0097	0.98	0.22	0.0097
523	0.48	0.00	NR	1.02	1.12	NR
525	NR	-	NR	NR	-	NR
526	0.49	0.45	0.04	0.99	0.45	0.04
529	0.47	-0.45	0.002	0.92	-1.12	0.002
530	0.50	0.90	1.5%	1.00	0.67	1.5%
534	0.49	0.45	NR	0.99	0.45	NR
535	0.39	-4.05	0.03Pb	0.76	-4.72	0.03Pb
536	0.48	0.00	0.02	0.96	-0.22	0.05
537	0.39	-4.05	NR	0.78	-4.27	NR
538	0.50	0.90	0.49	0.98	0.22	0.27
540	NR	-	NR	NR	-	NR
541	0.51	1.35	22%	1.02	1.12	22%
542	0.46	-0.90	0.01	0.93	-0.90	0.01
543	0.37	-4.95	0.98	0.93	-0.90	0.98
547	0.47	-0.45	0.01	0.94	-0.67	0.02
549	0.48	0.00	0.014	0.96	-0.22	0.014
555A	0.49	0.45	$x \pm 0.03x$	0.97	0.00	$x \pm 0.03x$
555B	0.46	-0.90	$x \pm 0.03x$	1.00	0.67	$x \pm 0.03x$
555C	0.49	0.45	$x \pm 0.08x$	0.98	0.22	$x \pm 0.08x$
560	0.50	0.90	0.10	0.98	0.22	0.20
561	0.47	-0.45	NR	1.00	0.67	NR
563	0.46	-0.90	0.07	0.93	-0.90	0.14
565	0.49	0.45	5%	0.98	0.22	5%
566	0.51	1.35	3%	1.13	3.60	3%
568	0.49	0.45	0.022	0.95	-0.45	0.022
571	0.486	0.27	4.003%	0.979	0.20	4.003%
572	0.43	-2.25	0.03	0.89	-1.80	0.03

Table 7: Reported results and calculated z-scores for Lead (cont'd)

Code No.	Lead (mg/l)					
	Sample A			Sample B		
	Result	z-score	Uncertainty (±)	Result	z-score	Uncertainty (±)
575	0.46	-0.90	0.04	0.93	-0.90	0.04
576	0.49	0.45	0.15	0.98	0.22	0.20
578	0.48	0.00	0.028	0.97	0.00	0.028
581	0.47	-0.45	0.003	0.95	-0.45	0.002
582A	0.51	1.35	0.03	0.97	0.00	0.05
582B	0.52	1.80	0.04	1.02	1.12	0.06
583	0.48	0.00	0.067	0.47	-11.24	0.067
586	0.48	0.00	ND	0.98	0.22	ND
587	0.49	0.45	0.056	0.99	0.45	0.056
588	0.34	-6.30	15%	1.06	2.02	15%
590	0.37	-4.95	10%	0.75	-4.95	10%
591	0.51	1.35	6%	1.01	0.90	6%
592	0.49	0.45	1.23%	0.97	0.00	1.23%
593	0.47	-0.45	0.03	0.95	-0.45	0.06
594	0.43	-2.25	0.02	0.92	-1.12	0.02
596	0.51	1.35	0.031	1.04	1.57	0.06
597	0.49	0.45	0.060	0.96	-0.22	0.120
598	0.47	-0.45	0.01	0.97	0.00	0.01
599	0.49	0.45	2.40%	1.00	0.67	2.40%
No.of results	57			57		
Median	0.48			0.97		
Normalised IQR	0.02			0.04		
Robust CV	4.6			4.6		
Maximum	1.79			3.62		
Minimum	0.23			0.47		
Range	1.56			3.15		

* Note: NR = Not Reported, ND = Not Detected

z-scores outside the satisfactory range, i.e. $|z| \geq 3$, are shown in **bold**

Table 8: Reported results and calculated z-scores for Nickel

Code No.	Nickel (mg/l)					
	Sample A			Sample B		
	Result	z-score	Uncertainty ($\pm$)	Result	z-score	Uncertainty ($\pm$)
500	0.46	-0.86	3.61	0.94	-0.49	3.61
501	0.46	-0.86	0.031	0.92	-0.98	0.062
503	0.50	0.86	$x \pm 0.10x$	0.97	0.25	$x \pm 0.10x$
504	0.49	0.43	NR	0.91	-1.23	NR
505	0.45	-1.28	NR	0.92	-0.98	NR
507	0.442	-1.63	0.031	0.884	-1.86	0.063
508	0.47	-0.43	3.9%	0.94	-0.49	3.9%
509	0.49	0.43	0.00146	0.94	-0.49	0.00593
510	0.473	-0.30	0.038	0.923	-0.91	0.038
513	0.48	0.00	0.013	0.95	-0.25	0.025
514	NR	-	NR	NR	-	NR
516	0.49	0.43	NR	0.98	0.49	NR
519	0.4573	-0.97	0.00001x	0.9119	-1.18	0.00001x
520	0.60	5.14	0.065404834	1.09	3.19	0.065404834
522	0.49	0.43	0.0122	0.98	0.49	0.0122
523	0.50	0.86	NR	1.02	1.47	NR
525	NR	-	NR	NR	-	NR
526	0.50	0.86	0.04	0.99	0.74	0.04
529	0.47	-0.43	0.002	0.92	-0.98	0.002
530	0.48	0.00	1.0%	0.96	0.00	1.0%
534	0.47	-0.43	NR	0.94	-0.49	NR
535	0.38	-4.28	NR	0.81	-3.68	NR
536	0.46	-0.86	0.05	0.96	0.00	0.09
537	0.47	-0.43	NR	1.01	1.23	NR
538	0.47	-0.43	1.23	0.98	0.49	0.28
540	NR	-	NR	NR	-	NR
541	0.52	1.71	22%	1.03	1.72	22%
542	0.50	0.86	0.01	1.01	1.23	0.01
543	0.42	-2.57	0.82	0.93	-0.74	0.82
547	0.48	0.00	0.01	0.95	-0.25	0.01
549	0.47	-0.43	0.006	0.95	-0.25	0.006
555A	0.50	0.86	$x \pm 0.05x$	1.00	0.98	$x \pm 0.05x$
555B	0.43	-2.14	$x \pm 0.03x$	0.96	0.00	$x \pm 0.03x$
555C	0.46	-0.86	$x \pm 0.1x$	0.97	0.25	$x \pm 0.1x$
560	0.48	0.00	0.10	0.93	-0.74	0.09
561	0.46	-0.86	NR	0.96	0.00	NR
563	0.46	-0.86	0.05	0.94	-0.49	0.09
565	0.37	-4.71	5%	0.83	-3.19	5%
566	0.47	-0.43	2%	1.03	1.72	2%
568	0.48	0.00	0.028	0.95	-0.25	0.028
571	0.492	0.51	4.914%	0.996	0.88	4.914%
572	0.45	-1.28	0.03	0.91	-1.23	0.03

Table 8: Reported results and calculated z-scores for Nickel (cont'd)

Code No.	Nickel (mg/l)					
	Sample A			Sample B		
	Result	z-score	Uncertainty (±)	Result	z-score	Uncertainty (±)
575	0.45	-1.28	0.04	0.94	-0.49	0.04
576	0.50	0.86	0.13	1.01	1.23	0.16
578	0.49	0.43	0.025	0.97	0.25	0.025
581	0.48	0.00	0.003	0.96	0.00	0.003
582A	0.48	0.00	0.03	0.97	0.25	0.06
582B	0.52	1.71	0.02	1.04	1.96	0.04
583	0.51	1.28	0.032	0.69	-6.62	0.032
586	0.48	0.00	ND	0.97	0.25	ND
587	0.49	0.43	0.056	0.99	0.74	0.056
588	0.56	3.43	15%	1.09	3.19	15%
590	0.35	-5.57	10%	0.72	-5.89	10%
591	0.51	1.28	11%	1.01	1.23	11%
592	0.49	0.43	0.88%	0.97	0.25	0.88%
593	0.48	0.00	0.01	0.97	0.25	0.02
594	0.57	3.85	0.02	1.10	3.43	0.02
596	0.48	0.00	NR	0.96	0.00	NR
597	0.43	-2.14	0.044	0.85	-2.70	0.087
598	0.47	-0.43	0.01	0.98	0.49	0.01
599	0.51	1.28	2.00%	0.98	0.49	2.00%
No.of results	58			58		
Median	0.48			0.96		
Normalised IQR	0.02			0.04		
Robust CV	4.9			4.2		
Maximum	0.60			1.10		
Minimum	0.35			0.69		
Range	0.25			0.41		

* Note: NR = Not Reported, ND = Not Detected

z-scores outside the satisfactory range, i.e. $|z| \geq 3$, are shown in **bold**

Table 9: Reported results and calculated z-scores for Zinc

Code No.	Zinc (mg/l)					
	Sample A			Sample B		
	Result	z-score	Uncertainty ($\pm$)	Result	z-score	Uncertainty ($\pm$)
500	0.32	-3.50	1.32	0.61	-3.86	1.32
501	0.37	-2.34	0.024	0.72	-2.51	0.046
503	0.45	-0.47	$x \pm 0.07x$	0.83	-1.17	$x \pm 0.07x$
504	0.47	0.00	NR	0.99	0.80	NR
505	0.50	0.70	NR	1.00	0.92	NR
507	0.428	-0.98	0.030	0.849	-0.93	0.060
508	0.45	-0.47	7.8%	0.91	-0.18	7.8%
509	0.48	0.23	0.00098	0.97	0.55	0.00375
510	0.439	-0.72	0.043	0.857	-0.83	0.043
513	NR	-	NR	NR	-	NR
514	NR	-	NR	NR	-	NR
516	0.49	0.47	NR	0.98	0.67	NR
519	0.4143	-1.30	0.00063x	0.8412	-1.03	0.00063x
520	0.63	3.74	0.184946324	1.02	1.17	0.184946324
522	0.44	-0.70	0.0103	0.88	-0.55	0.0103
523	0.50	0.70	NR	1.00	0.92	NR
525	NR	-	NR	NR	-	NR
526	0.50	0.70	0.04	0.98	0.67	0.04
529	0.44	-0.70	0.07	0.86	-0.80	0.07
530	0.49	0.47	1.0%	0.94	0.18	1.0%
534	0.47	0.00	NR	0.93	0.06	NR
535	0.47	0.00	NR	0.92	-0.06	NR
536	0.47	0.00	0.06	0.92	-0.06	0.11
537	0.46	-0.23	NR	0.88	-0.55	NR
538	0.42	-1.17	0.00	0.98	0.67	0.21
540	0.44	-0.70	0.02	0.85	-0.92	0.02
541	0.40	-1.64	22%	0.87	-0.67	22%
542	0.51	0.93	0.01	1.00	0.92	0.01
543	0.16	-7.24	0.13	0.41	-6.32	0.13
547	0.47	0.00	0.01	0.92	-0.06	0.02
549	0.47	0.00	0.004	0.92	-0.06	0.004
555A	0.49	0.47	$x \pm 0.06x$	0.96	0.43	$x \pm 0.06x$
555B	0.51	0.93	$x \pm 0.17x$	1.00	0.92	$x \pm 0.17x$
555C	0.47	0.00	$x \pm 0.12x$	0.92	-0.06	$x \pm 0.12x$
560	0.44	-0.70	0.07	0.90	-0.31	0.13
561	0.47	0.00	NR	0.96	0.43	NR
563	0.42	-1.17	0.06	0.81	-1.41	0.11
565	0.49	0.47	4.1%	0.98	0.67	4.1%
566	0.46	-0.23	3%	0.96	0.43	3%
568	0.43	-0.93	0.034	0.86	-0.80	0.034
571	0.486	0.37	3.222%	0.962	0.45	3.222%
572	0.42	-1.17	0.02	0.86	-0.80	0.02

Table 9: Reported results and calculated z-scores for Zinc (cont'd)

Code No.	Zinc (mg/l)					
	Sample A			Sample B		
	Result	z-score	Uncertainty (±)	Result	z-score	Uncertainty (±)
575	0.39	-1.87	0.05	0.88	-0.55	0.05
576	0.47	0.00	0.11	0.93	0.06	0.19
578	0.49	0.47	0.021	0.97	0.55	0.021
581	0.46	-0.23	0.002	0.92	-0.06	0.003
582A	0.48	0.23	0.03	0.94	0.18	0.05
582B	0.50	0.70	0.02	0.99	0.80	0.04
583	0.52	1.17	0.036	0.76	-2.02	0.036
586	0.50	0.70	0.06	0.98	0.67	0.06
587	0.51	0.93	0.059	0.97	0.55	0.059
588	0.43	-0.93	15%	0.78	-1.78	15%
590	0.39	-1.87	10%	0.77	-1.90	10%
591	0.52	1.17	7%	0.99	0.80	7%
592	0.49	0.47	1.03%	0.97	0.55	1.03%
593	0.48	0.23	0.02	0.95	0.31	0.03
594	0.40	-1.64	0.02	0.90	-0.31	0.02
596	0.43	-0.93	0.034	0.84	-1.04	0.068
597	0.49	0.47	0.045	0.93	0.06	0.084
598	0.48	0.23	0.01	0.97	0.55	0.01
599	0.50	0.70	NR	0.97	0.55	NR
No. of results	58			58		
Median	0.47			0.93		
Normalised IQR	0.04			0.08		
Robust CV	9.1			8.8		
Maximum	0.63			1.02		
Minimum	0.16			0.41		
Range	0.47			0.61		

* Note: NR = Not Reported

z-scores outside the satisfactory range, i.e. $|z| \geq 3$, are shown in **bold**

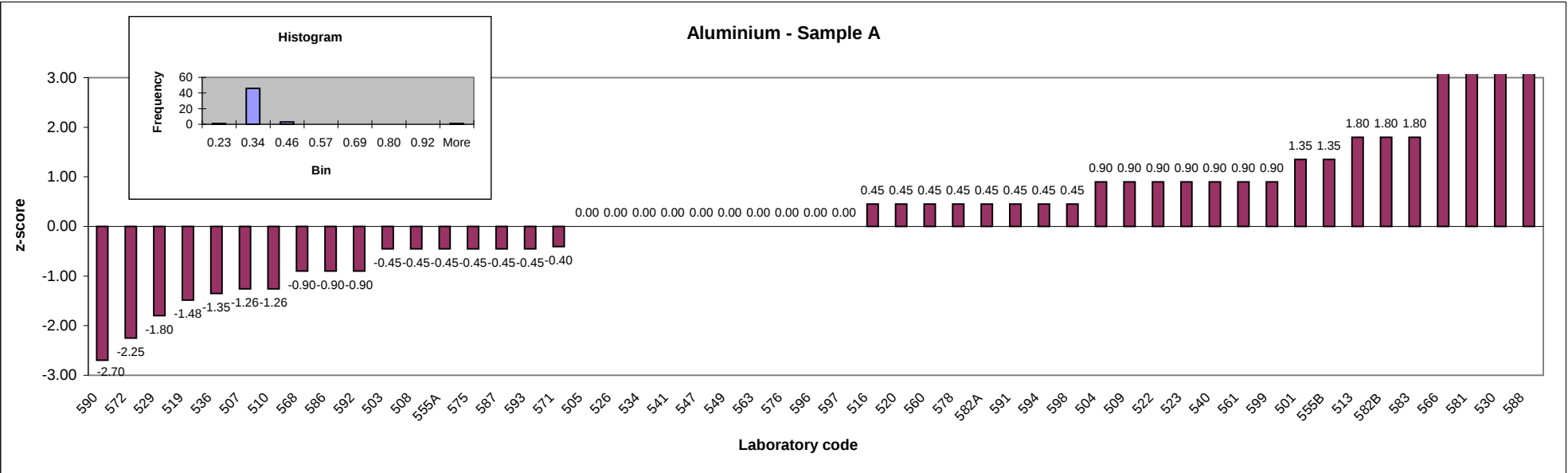


Figure 1: Ordered z-score chart for Aluminium - Sample A

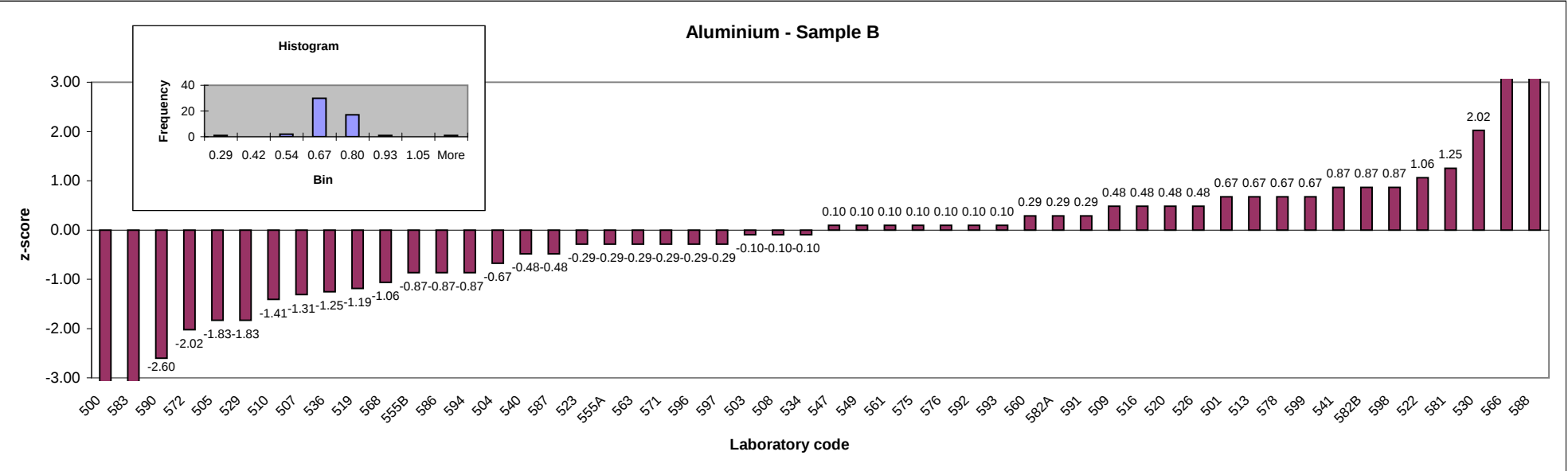


Figure 2: Ordered z-score chart for Aluminium - Sample B

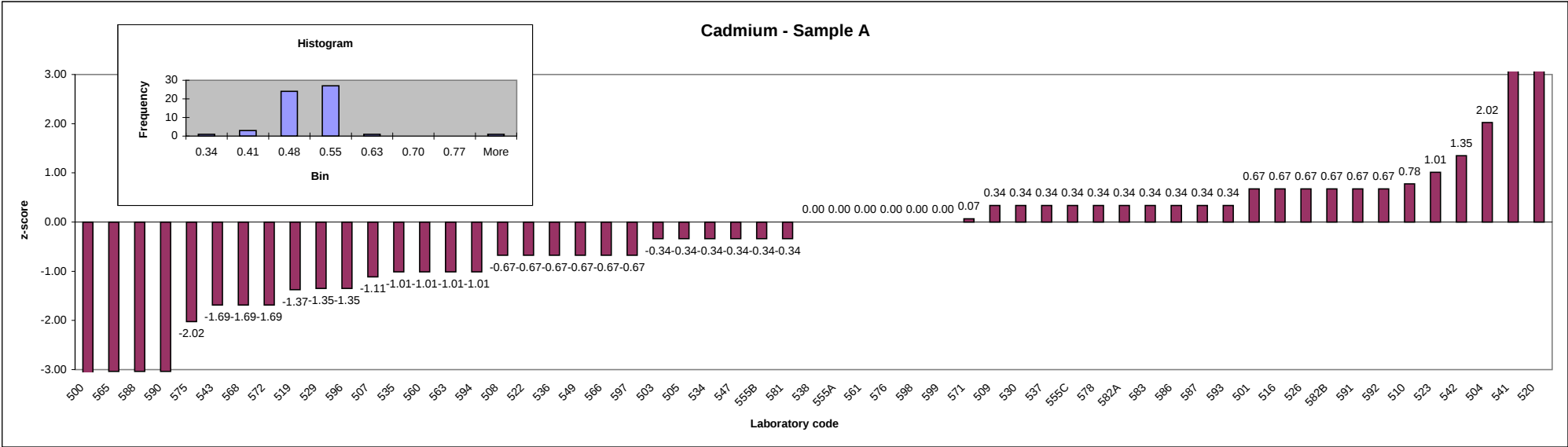


Figure 3: Ordered z-score chart for Cadmium - Sample A

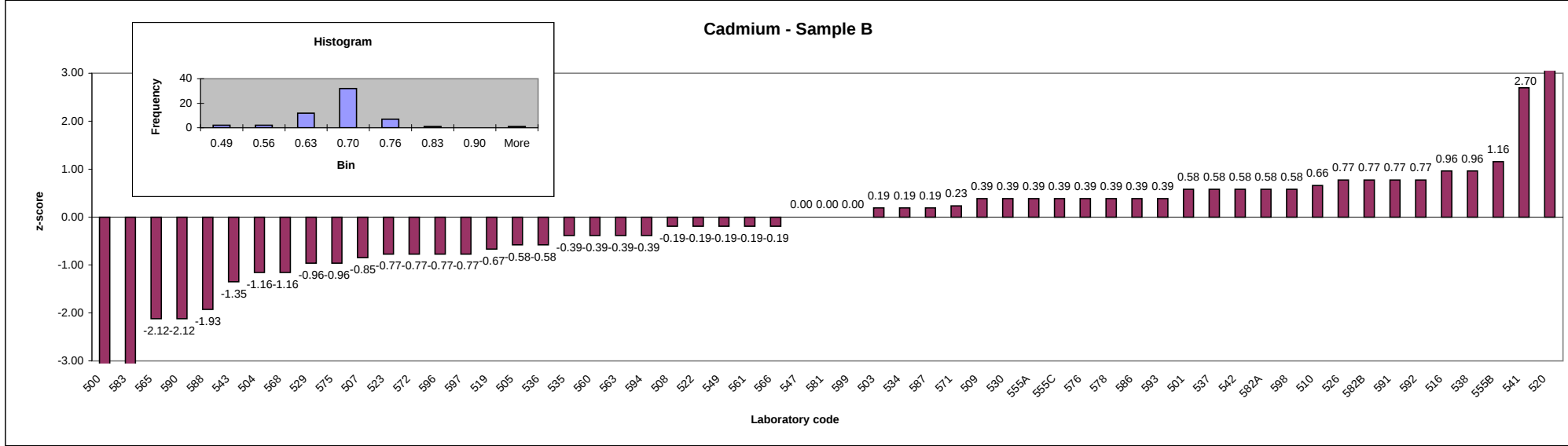


Figure 4: Ordered z-score chart for Cadmium - Sample B

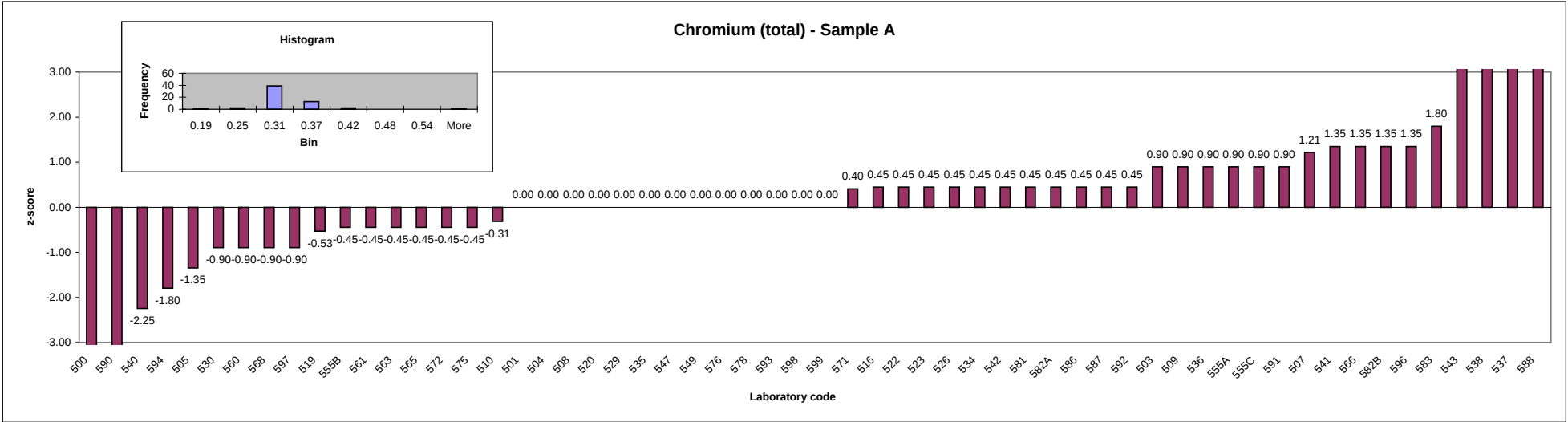


Figure 5: Ordered z-score chart for Chromium - Sample A

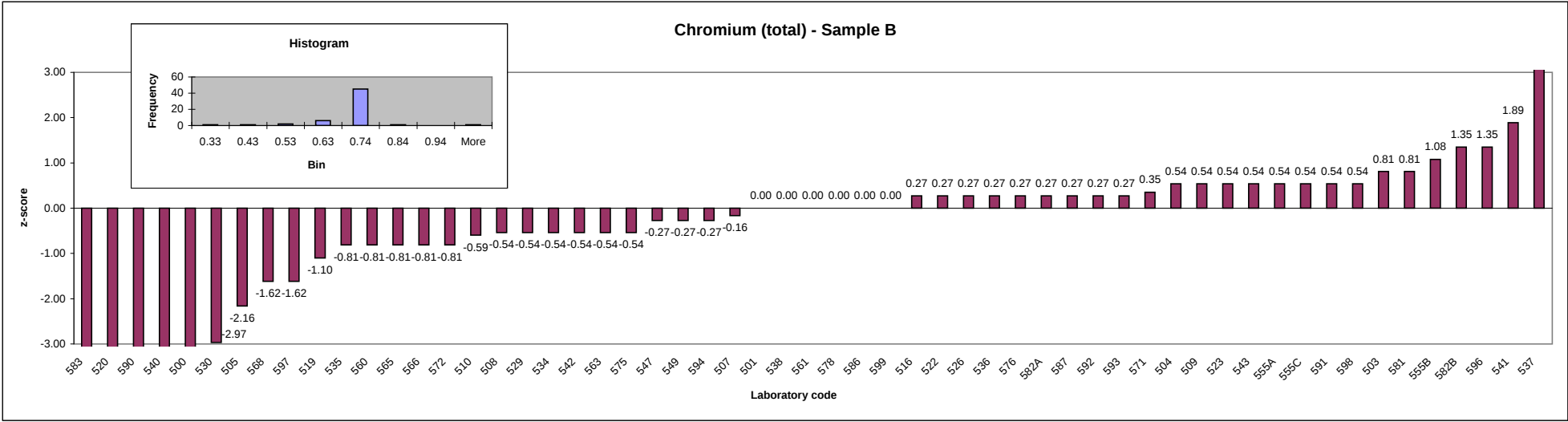


Figure 6: Ordered z-score chart for Chromium - Sample B

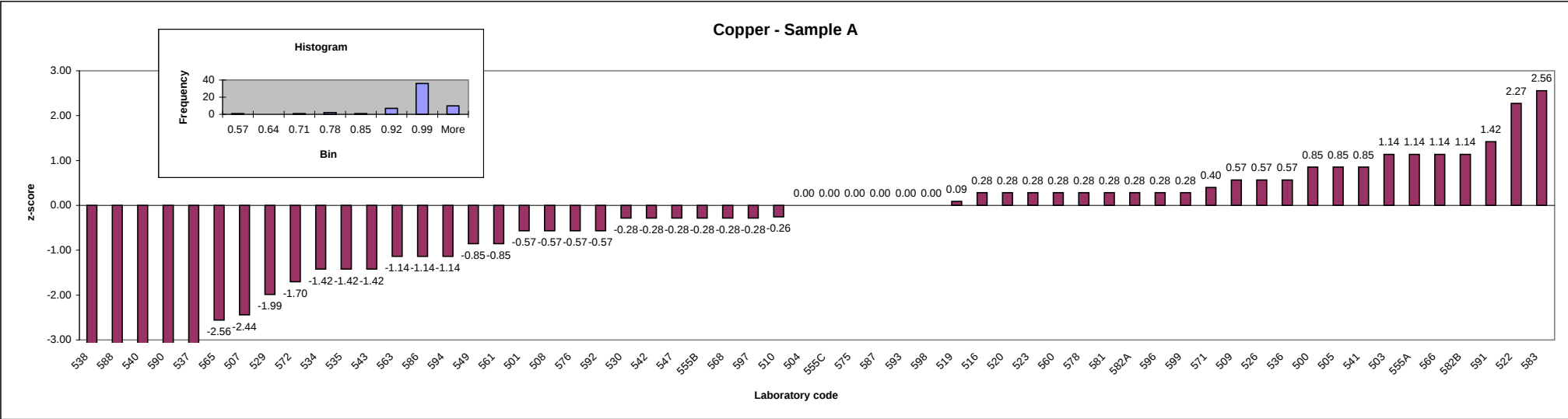


Figure 7: Ordered z-score chart for Copper - Sample A

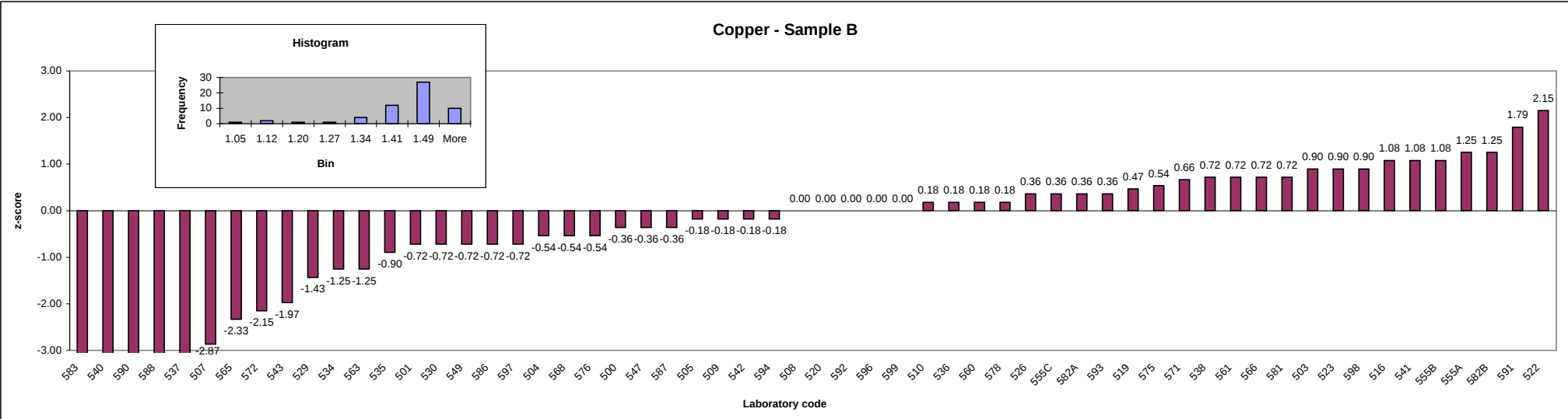


Figure 8: Ordered z-score chart for Copper - Sample B

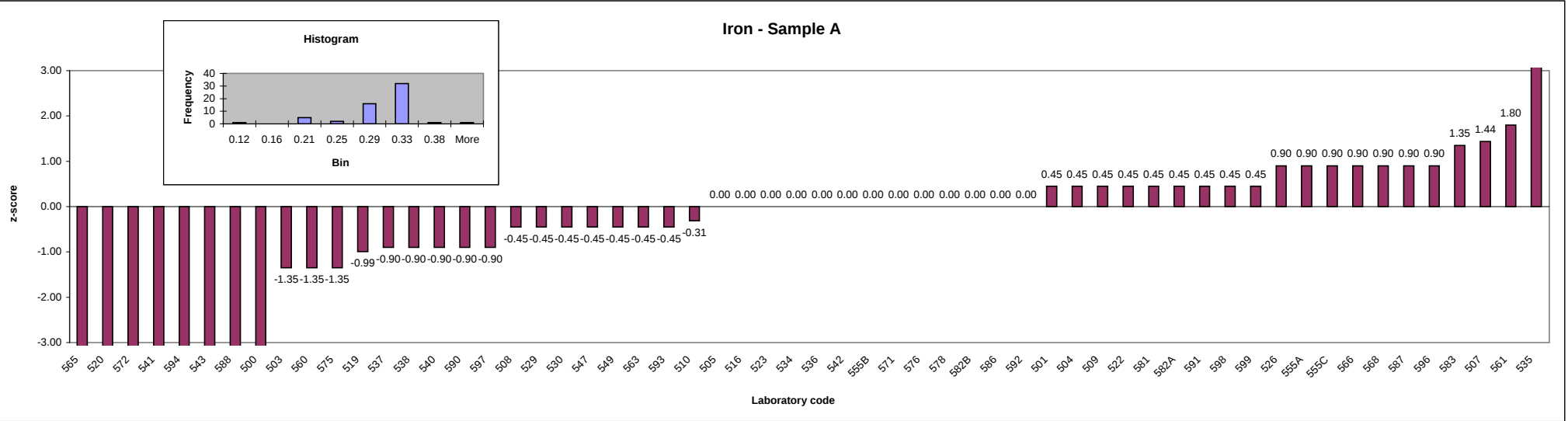


Figure 9: Ordered z-score chart for Iron - Sample A

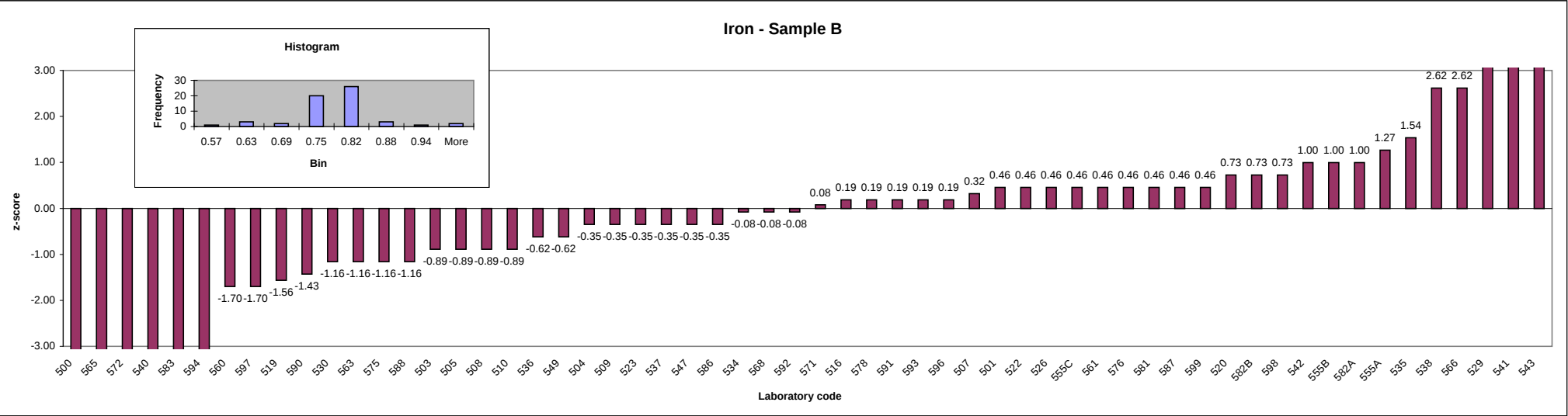


Figure 10: Ordered z-score chart for Iron - Sample B

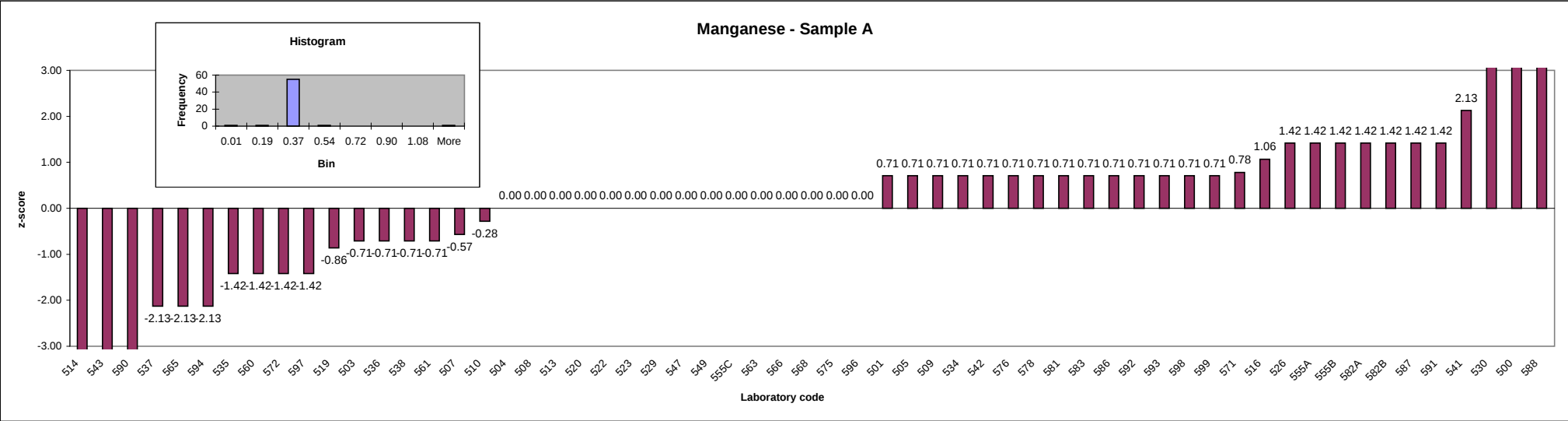


Figure 11: Ordered z-score chart for Manganese - Sample A

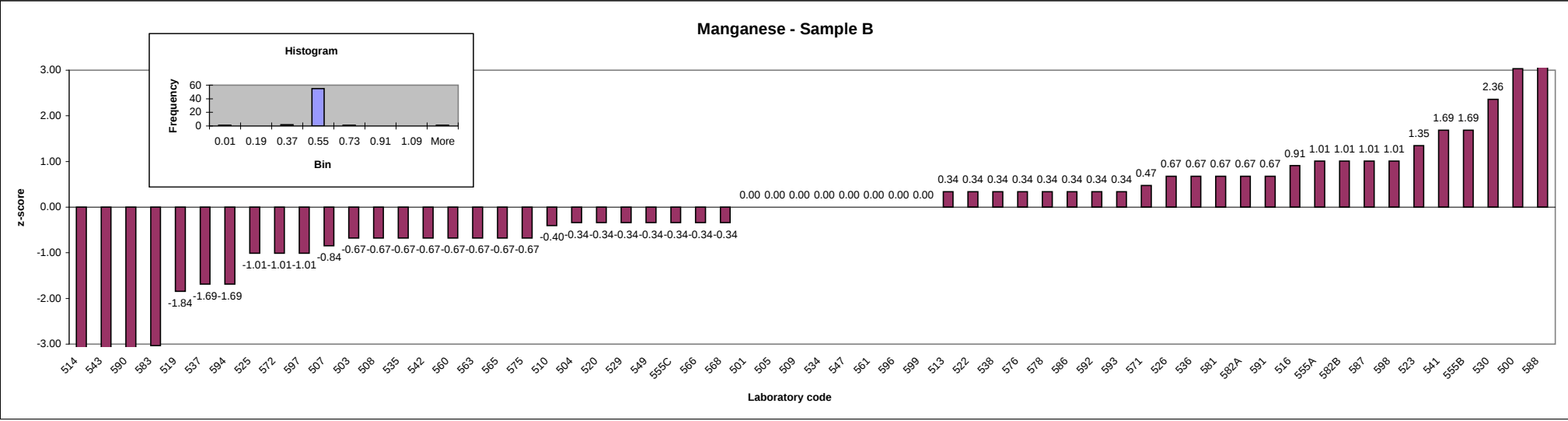


Figure 12: Ordered z-score chart for Manganese - Sample B

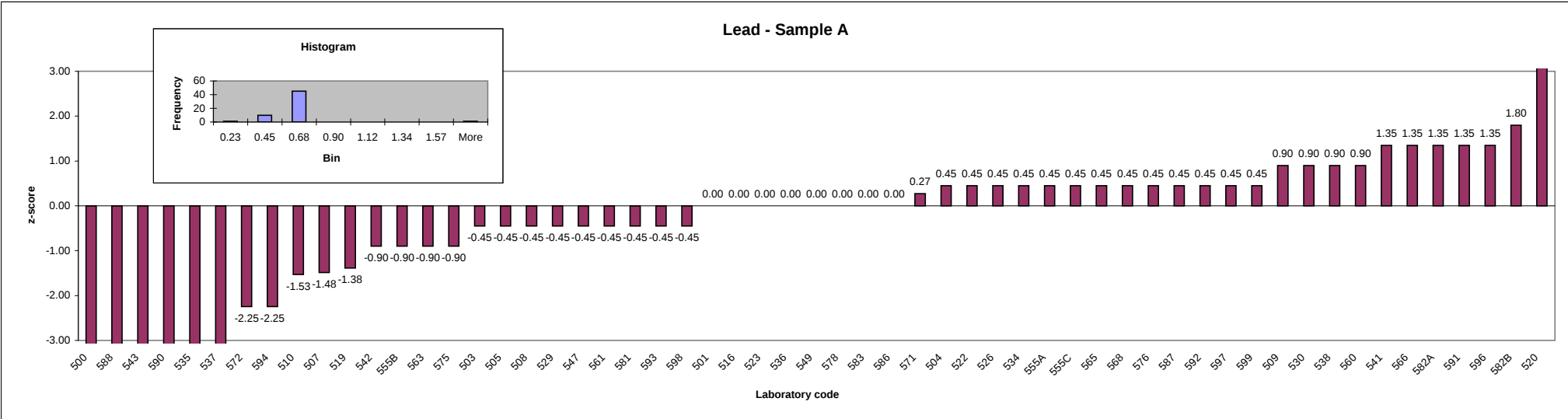


Figure 13: Ordered z-score chart for Lead - Sample A

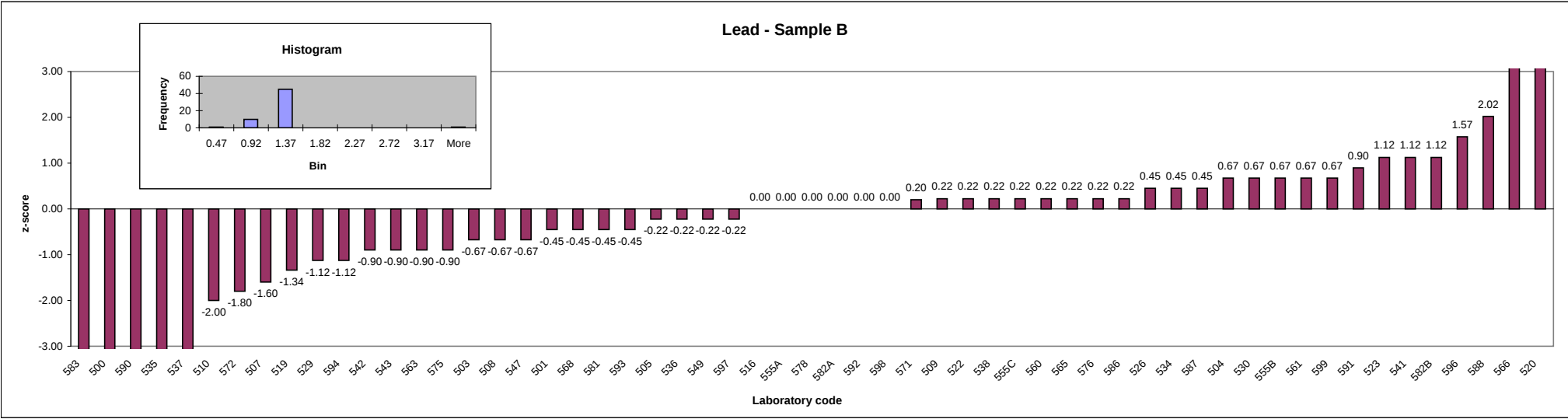


Figure 14: Ordered z-score chart for Lead - Sample B

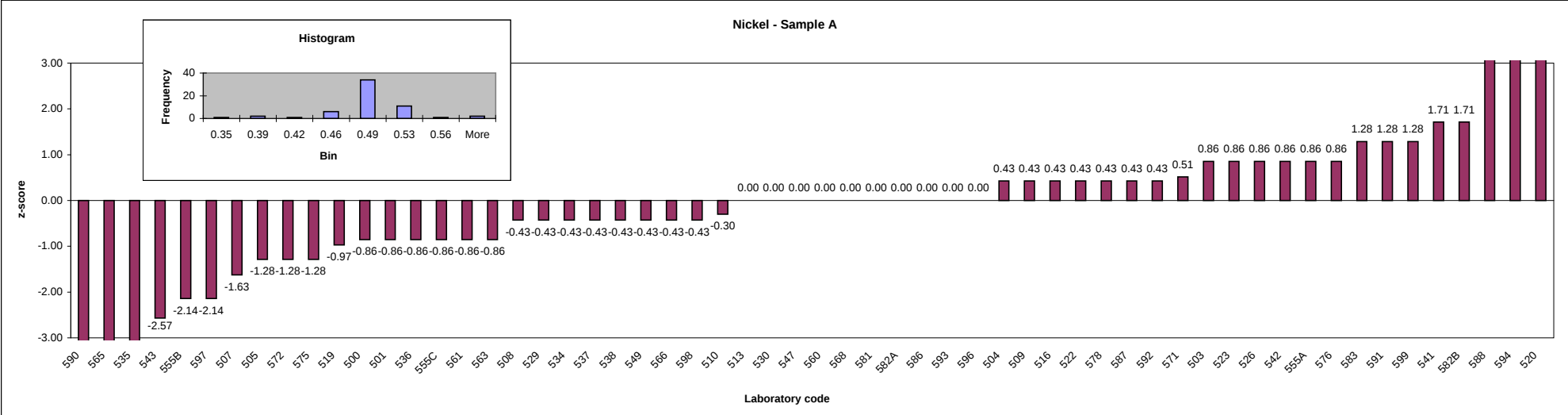


Figure 15: Ordered z-score chart for Nickel - Sample A

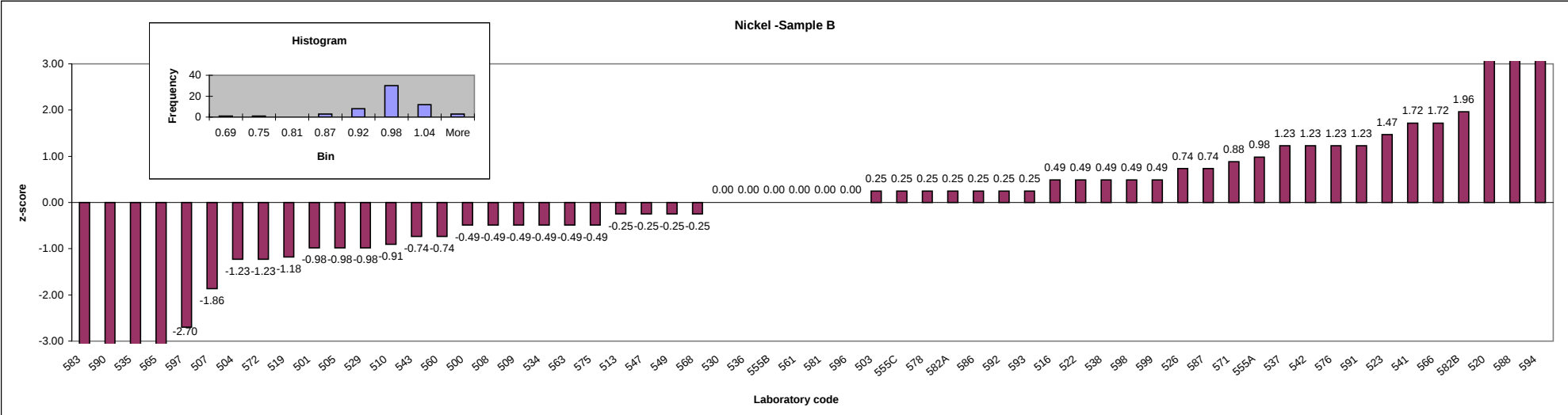


Figure 16: Ordered z-score chart for Nickel - Sample B

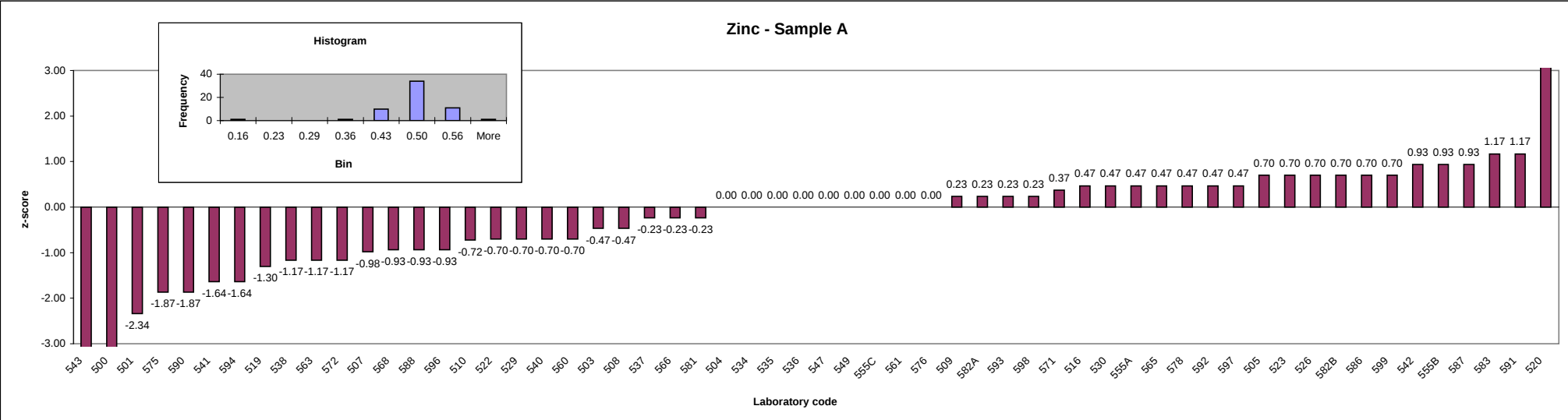


Figure 17: Ordered z-score chart for Zinc - Sample A

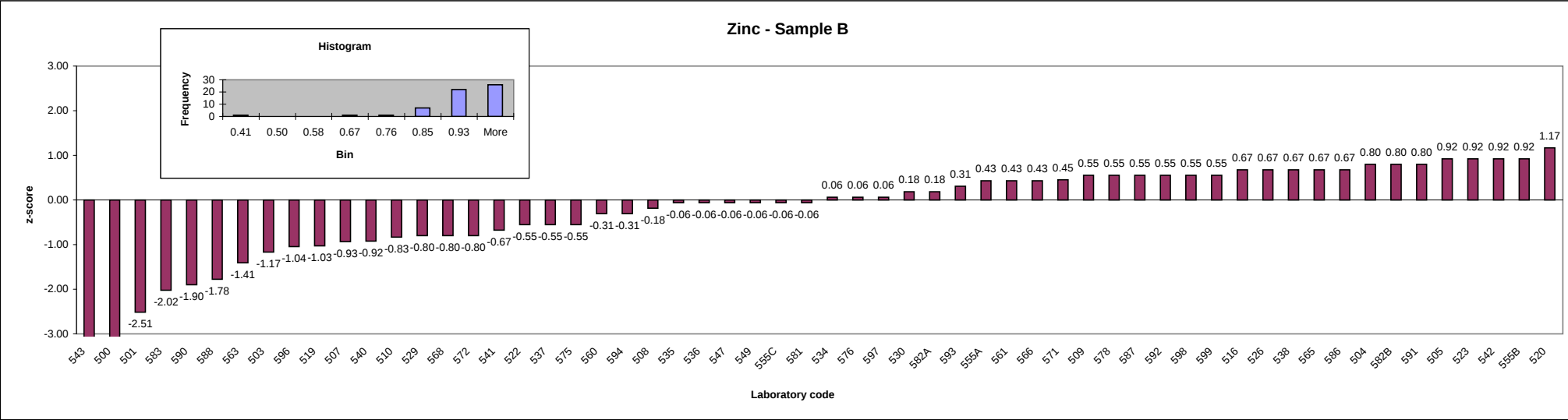


Figure 18: Ordered z-score chart for Zinc - Sample B

Appendix 1: List of participating accreditation bodies

No.	Economy	Accreditation Body	No. of Laboratories
1.	Brunei Darussalam	Construction Planning and Research Unit (CPRU)	2
2.	Canada	Standards Council of Canada (SCC)	6
3.	China	China National Accreditation Service for Conformity Assessment (CNAS)	3
4.	India	National Accreditation Board for Testing and Calibration Laboratories (NABL)	4
5.	Japan	International Accreditation Japan (IAJapan)	1
		Japan Chemical Laboratory Accreditation (JCLA)	1
		The Japan Accreditation Board for Conformity Assessment (JAB)	2
6.	Malaysia	Department of Standards Malaysia (Standards Malaysia)	13
7.	New Zealand	International Accreditation New Zealand (IANZ)	3
8.	Philippines	Philippine Accreditation Office (PAO)	3
9.	Russia	Association of Analytical Centres "Analitica" (AAC ANALITICA)	3
10.	Singapore	Singapore Accreditation Council (SAC)	3
11.	South Korea	Korea Laboratory Accreditation Scheme (KOLAS)	3
12.	Sri Lanka	Sri Lanka Accreditation Board for Conformity Assessment (SLAB)	3
13.	Taiwan	Taiwan Accreditation Foundation (TAF)	3
14.	United States of America	Perry Johnson Laboratory Accreditation, Inc. (PJLA)	1
		American Association for Laboratory Accreditation (A2LA)	1
15.	Vietnam	Bureau of Accreditation Vietnam (BoA)	3

Appendix 2a: Homogeneity Data for APLAC T064 - Trace Metals in Water using ICP-OES

Sample: Aluminium (Sample A)

Bottle no.	Replicate 1 (A1) (mg/l)	Replicate 2 (A2) (mg/l)
45	0.29	0.30
98	0.29	0.29
78	0.29	0.28
35	0.30	0.29
59	0.30	0.31
87	0.29	0.29
20	0.29	0.30
69	0.29	0.31
8	0.28	0.29
15	0.30	0.29

Mean = **0.29**
 n = **20**
 Target standard deviation (σ_p) = **0.0440**
 Analytical SD (σ_{an}) = **0.0074**
 Sampling variance (s^2_{sam}) = **0.00001**
 Critical value = **0.0004**

Test	Cochran	σ_{an}/σ_p	$s^2_{sam} < \text{critical}$
Test Value	0.3636	0.1685	0.00001
Critical Value	0.6020	0.5000	0.0004
Result	PASS	PASS	PASS

Sample: Aluminium (Sample B)

Bottle no.	Replicate 1 (A1) (mg/l)	Replicate 2 (A2) (mg/l)
67	0.68	0.68
13	0.66	0.65
26	0.66	0.66
9	0.67	0.66
50	0.68	0.67
97	0.65	0.69
38	0.66	0.65
3	0.67	0.68
22	0.66	0.68
43	0.66	0.64

Mean = **0.67**
 n = **20**
 Target standard deviation (σ_p) = **0.0998**
 Analytical SD (σ_{an}) = **0.0120**
 Sampling variance (s^2_{sam}) = **0.00003**
 Critical value = **0.0018**

Test	Cochran	σ_{an}/σ_p	$s^2_{sam} < \text{critical}$
Test Value	0.5517	0.1206	0.00003
Critical Value	0.6020	0.5000	0.0018
Result	PASS	PASS	PASS

Therefore samples are sufficiently homogeneous

Appendix 2b: Homogeneity Data for APLAC T064 - Trace Metals in Water using ICP-OES

Sample: Cadmium (Sample A)

Bottle no.	Replicate 1 (A1) (mg/l)	Replicate 2 (A2) (mg/l)
45	0.49	0.51
98	0.49	0.50
78	0.49	0.48
35	0.51	0.50
59	0.49	0.49
87	0.49	0.49
20	0.49	0.50
69	0.49	0.50
8	0.48	0.49
15	0.49	0.50

Mean = **0.49**
 n = **20**
 Target standard deviation (σ_p) = **0.0740**
 Analytical SD (σ_{an}) = **0.0074**
 Sampling variance (s^2_{sam}) = **0.00001**
 Critical value = **0.0010**

Test	Cochran	σ_{an}/σ_p	$s^2_{sam} < \text{critical}$
Test Value	0.3636	0.1002	0.00001
Critical Value	0.6020	0.5000	0.0010
Result	PASS	PASS	PASS

Sample: Cadmium (Sample B)

Bottle no.	Replicate 1 (A1) (mg/l)	Replicate 2 (A2) (mg/l)
67	0.67	0.68
13	0.67	0.67
26	0.67	0.67
9	0.68	0.67
50	0.69	0.68
97	0.67	0.69
38	0.67	0.67
3	0.68	0.68
22	0.67	0.69
43	0.68	0.65

Mean = **0.68**
 n = **20**
 Target standard deviation (σ_p) = **0.1148**
 Analytical SD (σ_{an}) = **0.0100**
 Sampling variance (s^2_{sam}) = **0**
 Critical value = **0.0023**

Test	Cochran	σ_{an}/σ_p	$s^2_{sam} < \text{critical}$
Test Value	0.4500	0.0871	0
Critical Value	0.6020	0.5000	0.0023
Result	PASS	PASS	PASS

Therefore samples are sufficiently homogeneous

Appendix 2c: Homogeneity Data for APLAC T064 - Trace Metals in Water using ICP-OES

Sample: Chromium (total) (Sample A)

Bottle no.	Replicate 1 (A1) (mg/l)	Replicate 2 (A2) (mg/l)
45	0.30	0.30
98	0.30	0.29
78	0.29	0.29
35	0.30	0.31
59	0.29	0.29
87	0.29	0.30
20	0.30	0.29
69	0.29	0.30
8	0.30	0.29
15	0.28	0.29

Mean = **0.29**
 n = **20**
 Target standard deviation (σ_p) = **0.0442**
 Analytical SD (σ_{an}) = **0.0059**
 Sampling variance (s^2_{sam}) = **0.00001**
 Critical value = **0.0004**

Test	Cochran	σ_{an}/σ_p	$s^2_{sam} < \text{critical}$
Test Value	0.1429	0.1339	0.00001
Critical Value	0.6020	0.5000	0.0004
Result	PASS	PASS	PASS

Sample: Chromium (total) (Sample B)

Bottle no.	Replicate 1 (A1) (mg/l)	Replicate 2 (A2) (mg/l)
67	0.64	0.66
13	0.65	0.64
26	0.65	0.64
9	0.65	0.65
50	0.65	0.65
97	0.64	0.65
38	0.65	0.64
3	0.65	0.65
22	0.64	0.66
43	0.65	0.62

Mean = **0.65**
 n = **20**
 Target standard deviation (σ_p) = **0.0970**
 Analytical SD (σ_{an}) = **0.0102**
 Sampling variance (s^2_{sam}) = **0**
 Critical value = **0.0017**

Test	Cochran	σ_{an}/σ_p	$s^2_{sam} < \text{critical}$
Test Value	0.4286	0.1057	0
Critical Value	0.6020	0.5000	0.0017
Result	PASS	PASS	PASS

Therefore samples are sufficiently homogeneous

Appendix 2d: Homogeneity Data for APLAC T064 - Trace Metals in Water using ICP-OES

Sample: Copper (Sample A)

Bottle no.	Replicate 1 (A1) (mg/l)	Replicate 2 (A2) (mg/l)
45	1.02	1.03
98	1.00	1.02
78	1.02	0.99
35	1.04	1.02
59	1.01	1.00
87	1.01	1.01
20	1.02	1.02
69	1.01	1.04
8	1.00	1.01
15	1.01	1.03

Mean = **1.02**
 n = **20**
 Target standard deviation (σ_p) = **0.1523**
 Analytical SD (σ_{an}) = **0.0128**
 Sampling variance (s^2_{sam}) = **0.00001**
 Critical value = **0.0041**

Test	Cochran	σ_{an}/σ_p	$s^2_{sam} < \text{critical}$
Test Value	0.2727	0.0843	0.00001
Critical Value	0.6020	0.5000	0.0041
Result	PASS	PASS	PASS

Sample: Copper (Sample B)

Bottle no.	Replicate 1 (A1) (mg/l)	Replicate 2 (A2) (mg/l)
67	1.50	1.52
13	1.49	1.48
26	1.50	1.50
9	1.50	1.49
50	1.51	1.50
97	1.48	1.52
38	1.49	1.48
3	1.50	1.51
22	1.49	1.52
43	1.50	1.45

Mean = **1.50**
 n = **20**
 Target standard deviation (σ_p) = **0.2245**
 Analytical SD (σ_{an}) = **0.0172**
 Sampling variance (s^2_{sam}) = **0**
 Critical value = **0.0088**

Test	Cochran	σ_{an}/σ_p	$s^2_{sam} < \text{critical}$
Test Value	0.4237	0.0765	0
Critical Value	0.6020	0.5000	0.0088
Result	PASS	PASS	PASS

Therefore samples are sufficiently homogeneous

Appendix 2e: Homogeneity Data for APLAC T064 - Trace Metals in Water using ICP-OES

Sample: Iron (Sample A)

Bottle no.	Replicate 1 (A1) (mg/l)	Replicate 2 (A2) (mg/l)
45	0.34	0.35
98	0.35	0.35
78	0.33	0.33
35	0.34	0.35
59	0.33	0.34
87	0.34	0.34
20	0.34	0.33
69	0.34	0.34
8	0.33	0.33
15	0.34	0.34

Mean = **0.34**
 n = **20**
 Target standard deviation (σ_p) = **0.0509**
 Analytical SD (σ_{an}) = **0.0045**
 Sampling variance (s^2_{sam}) = **0.00003**
 Critical value = **0.0005**

Test	Cochran	σ_{an}/σ_p	$s^2_{sam} < \text{critical}$
Test Value	0.2500	0.0879	0.00003
Critical Value	0.6020	0.5000	0.0005
Result	PASS	PASS	PASS

Sample: Iron (Sample B)

Bottle no.	Replicate 1 (A1) (mg/l)	Replicate 2 (A2) (mg/l)
67	0.75	0.83
13	0.81	0.83
26	0.82	0.81
9	0.82	0.82
50	0.84	0.85
97	0.82	0.84
38	0.84	0.82
3	0.80	0.83
22	0.80	0.83
43	0.84	0.79

Mean = **0.82**
 n = **20**
 Target standard deviation (σ_p) = **0.1229**
 Analytical SD (σ_{an}) = **0.0246**
 Sampling variance (s^2_{sam}) = **0**
 Critical value = **0.0032**

Test	Cochran	σ_{an}/σ_p	$s^2_{sam} < \text{critical}$
Test Value	0.5289	0.2001	0
Critical Value	0.6020	0.5000	0.0032
Result	PASS	PASS	PASS

Therefore samples are sufficiently homogeneous

Appendix 2f: Homogeneity Data for APLAC T064 - Trace Metals in Water using ICP-OES

Sample: Manganese (Sample A)

Bottle no.	Replicate 1 (A1) (mg/l)	Replicate 2 (A2) (mg/l)
45	0.32	0.32
98	0.31	0.32
78	0.32	0.31
35	0.32	0.32
59	0.31	0.31
87	0.31	0.32
20	0.32	0.32
69	0.32	0.32
8	0.31	0.31
15	0.32	0.32

Mean = 0.32
 n = 20
 Target standard deviation (σ_p) = 0.0475
 Analytical SD (σ_{an}) = 0.0039
 Sampling variance (s^2_{sam}) = 0.00001
 Critical value = 0.0004

Test	Cochran	σ_{an}/σ_p	$s^2_{sam} < \text{critical}$
Test Value	0.3333	0.0816	0.00001
Critical Value	0.6020	0.5000	0.0004
Result	PASS	PASS	PASS

Sample: Manganese (Sample B)

Bottle no.	Replicate 1 (A1) (mg/l)	Replicate 2 (A2) (mg/l)
67	0.51	0.51
13	0.50	0.49
26	0.50	0.50
9	0.50	0.50
50	0.50	0.50
97	0.50	0.51
38	0.50	0.50
3	0.50	0.51
22	0.50	0.51
43	0.50	0.48

Mean = 0.50
 n = 20
 Target standard deviation (σ_p) = 0.0752
 Analytical SD (σ_{an}) = 0.0063
 Sampling variance (s^2_{sam}) = 0.00001
 Critical value = 0.0010

Test	Cochran	σ_{an}/σ_p	$s^2_{sam} < \text{critical}$
Test Value	0.5000	0.0842	0.00001
Critical Value	0.6020	0.5000	0.0010
Result	PASS	PASS	PASS

Therefore samples are sufficiently homogeneous

Appendix 2g: Homogeneity Data for APLAC T064 - Trace Metals in Water using ICP-OES

Sample: Lead (Sample A)

Bottle no.	Replicate 1 (A1) (mg/l)	Replicate 2 (A2) (mg/l)
45	0.49	0.51
98	0.49	0.50
78	0.49	0.48
35	0.50	0.50
59	0.49	0.49
87	0.49	0.49
20	0.49	0.49
69	0.49	0.50
8	0.49	0.49
15	0.49	0.50

Mean = **0.49**
 n = **20**
 Target standard deviation (σ_p) = **0.0740**
 Analytical SD (σ_{an}) = **0.0063**
 Sampling variance (s^2_{sam}) = **0.000003**
 Critical value = **0.0010**

Test	Cochran	σ_{an}/σ_p	$s^2_{sam} < \text{critical}$
Test Value	0.5000	0.0855	0.000003
Critical Value	0.6020	0.5000	0.0010
Result	PASS	PASS	PASS

Sample: Lead (Sample B)

Bottle no.	Replicate 1 (A1) (mg/l)	Replicate 2 (A2) (mg/l)
67	0.96	0.99
13	0.96	0.95
26	0.96	0.96
9	0.97	0.97
50	0.98	0.97
97	0.97	0.99
38	0.97	0.95
3	0.96	0.98
22	0.96	0.98
43	0.97	0.95

Mean = **0.97**
 n = **20**
 Target standard deviation (σ_p) = **0.1451**
 Analytical SD (σ_{an}) = **0.0124**
 Sampling variance (s^2_{sam}) = **0**
 Critical value = **0.0037**

Test	Cochran	σ_{an}/σ_p	$s^2_{sam} < \text{critical}$
Test Value	0.2903	0.0858	0
Critical Value	0.6020	0.5000	0.0037
Result	PASS	PASS	PASS

Therefore samples are sufficiently homogeneous

Appendix 2h: Homogeneity Data for APLAC T064 - Trace Metals in Water using ICP-OES

Sample: Nickel (Sample A)

Bottle no.	Replicate 1 (A1) (mg/l)	Replicate 2 (A2) (mg/l)
45	0.51	0.52
98	0.51	0.51
78	0.51	0.50
35	0.52	0.52
59	0.50	0.50
87	0.51	0.51
20	0.51	0.51
69	0.51	0.52
8	0.50	0.51
15	0.51	0.51

Mean = **0.51**
 n = **20**
 Target standard deviation (σ_p) = **0.0765**
 Analytical SD (σ_{an}) = **0.0045**
 Sampling variance (s^2_{sam}) = **0.00002**
 Critical value = **0.0010**

Test	Cochran	σ_{an}/σ_p	$s^2_{sam} < \text{critical}$
Test Value	0.2500	0.0585	0.00002
Critical Value	0.6020	0.5000	0.0010
Result	PASS	PASS	PASS

Sample: Nickel (Sample B)

Bottle no.	Replicate 1 B1) (mg/l)	Replicate 2 (B2) (mg/l)
67	1.01	1.02
13	1.00	1.00
26	1.01	1.01
9	1.01	1.01
50	1.01	1.02
97	1.00	1.03
38	1.01	1.00
3	1.01	1.02
22	1.00	1.02
43	1.01	0.98

Mean = **1.01**
 n = **20**
 Target standard deviation (σ_p) = **0.1514**
 Analytical SD (σ_{an}) = **0.0114**
 Sampling variance (s^2_{sam}) = **0**
 Critical value = **0.0040**

Test	Cochran	σ_{an}/σ_p	$s^2_{sam} < \text{critical}$
Test Value	0.3462	0.0753	0
Critical Value	0.6020	0.5000	0.0040
Result	PASS	PASS	PASS

Therefore samples are sufficiently homogeneous

Appendix 2i: Homogeneity Data for APLAC T064 - Trace Metals in Water using ICP-OES

Sample: Zinc (Sample A)

Bottle no.	Replicate 1 (A1) (mg/l)	Replicate 2 (A2) (mg/l)
45	0.48	0.51
98	0.47	0.51
78	0.48	0.47
35	0.50	0.49
59	0.47	0.48
87	0.48	0.48
20	0.48	0.48
69	0.48	0.50
8	0.47	0.48
15	0.48	0.49

Mean = **0.48**
 n = **20**
 Target standard deviation (σ_p) = **0.0726**
 Analytical SD (σ_{an}) = **0.0130**
 Sampling variance (s^2_{sam}) = **0**
 Critical value = **0.0011**

Test	Cochran	σ_{an}/σ_p	$s^2_{sam} < \text{critical}$
Test Value	0.4706	0.1796	0
Critical Value	0.6020	0.5000	0.0011
Result	PASS	PASS	PASS

Sample: Zinc (Sample B)

Bottle no.	Replicate 1 (B1) (mg/l)	Replicate 2 (B2) (mg/l)
67	0.94	0.96
13	0.94	0.93
26	0.94	0.94
9	0.95	0.94
50	0.95	0.95
97	0.95	0.97
38	0.94	0.93
3	0.94	0.95
22	0.93	0.95
43	0.94	0.91

Mean = **0.94**
 n = **20**
 Target standard deviation (σ_p) = **0.1414**
 Analytical SD (σ_{an}) = **0.0112**
 Sampling variance (s^2_{sam}) = **0.00003**
 Critical value = **0.0035**

Test	Cochran	σ_{an}/σ_p	$s^2_{sam} < \text{critical}$
Test Value	0.3600	0.0791	0.00003
Critical Value	0.6020	0.5000	0.0035
Result	PASS	PASS	PASS

Therefore samples are sufficiently homogeneous

Appendix 3

INSTRUCTIONS TO ACCREDITATION BODIES**1. Introduction**

The APLAC T064 Proficiency Testing Program “Trace Metals in Water” is organized by Department of Standards Malaysia in collaboration with Department of Chemistry, Malaysia. The objective of this programme is to evaluate the competence of accredited laboratories in identification of trace metals in water.

2. Samples

Each laboratory is supplied with 2 samples each ~ 500ml and labelled as :

**APLAC T064
Sample A or Sample B**

Both samples are packed inside a box. Instructions and result sheets are included. There is no need to open the packaging. Upon receipt of the samples, kindly please complete the enclosed “RECEIPT FORM” and fax to the provided fax number below this form or email to razif@standardsmalaysia.gov.my.

3. Tests to be performed

Please refer to your copy of the “INSTRUCTIONS TO PARTICIPANTS” and “RESULTS SHEET” enclosed.

4. Sample Distribution

The mailing boxes are addressed to each participating laboratory and contain the samples of trace metals in water, instructions and results sheet (marked with their confidential lab code No.). These are to be sent to the laboratories within one week of receipt date. There is no need to open the packaging.

5. Documents to be submitted

- a) **No later than 12 September 2008** participating laboratories are requested to send the following to their accreditation body:
 - Complete results sheet
 - Any supporting documentation to assist in the interpretation of the results.
- b) **Also no later than 12 September 2008** participating laboratories are required to fax a copy of the results sheet to the address stated below.
- c) The accreditation body should collect, and email or faxed the documentation from participating laboratories **no later than 19 September 2008** to STANDARDS MALAYSIA.

The accreditation body is required to ensure that the above information has been supplied by their laboratories and should provide translation into English where necessary.

6. General Information

Additional information may be obtained from:

Department of Standards Malaysia (STANDARDS MALAYSIA)
Century Square, Level 1 & 2,
Blok 2300, Jalan Usahawan,
63000 Cyberjaya,
Selangor, MALAYSIA.
(Attn. Mr. Ahmad Razif Abd Rahim)
Fax No. : +603-83189339
Tel. No. : +603-83191400
E-mail : razif@standardsmalaysia.gov.my

Appendix 4**INSTRUCTIONS TO PARTICIPATING LABORATORIES****Introduction**

The APLAC T064 Proficiency Testing Program “Trace Metals in Water” is organized by Department of Standards Malaysia in collaboration with Department of Chemistry, Malaysia. The objective of this programme is to evaluate the competence of accredited laboratories in trace metals in water.

Instructions

To ensure that results from this program can be analysed properly, participants are asked to adhere carefully to the following instructions.

1. Two samples each ~ 500ml and labelled APLAC T064 Sample A and APLAC T064 Sample B have been supplied to each laboratory by your respective ABs. Please check your samples condition upon receipt. Please contact with your accreditation body if there is damaged samples.
2. Testing may commence as soon as samples are received. Store your samples in the original packaging in refrigerator at about 4°C until testing commences.
3. The samples are prepared synthetically thus acid digestion is not required prior to testing.
4. Participating laboratories are required to test the samples and determine the concentration (in mg/l) of the following trace metals:
 - Aluminium
 - Cadmium
 - Chromium (total)
 - Copper
 - Iron
 - Manganese
 - Lead
 - Nickel
 - Zinc

Test results are to be reported in the “RESULTS SHEET” and result figures reported are to be round up to 2 decimal places. Analysts should be aware of analyte stability and perform the tests in an appropriate order.

5. Participants should use routine test methods, which would normally used to test customer supplied samples and record the method using the provided results sheet. Please report the Measurement Uncertainty for each result.

6. The information on the identities and results of the participating laboratories will be kept confidential to the accreditation bodies and the organizers. Each participating laboratory will be assigned with a confidential code number.
7. Send the completed results sheet and any supporting documentation to your accreditation body **and** fax a copy of the results sheet no later than **12 September 2008** to:

Department of Standards Malaysia (STANDARDS MALAYSIA)
Century Square, Level 1 & 2,
Blok 2300, Jalan Usahawan,
63000 Cyberjaya,
Selangor, MALAYSIA.
(Attn. Mr. Ahmad Razif Abd Rahim)
Fax No. : +603-83189339
Tel No. : +603-83191400
E-mail : razif@standardsmalaysia.gov.my

Not later than : 12 September 2008

Appendix 5

RECEIPT FORM

For effective monitoring on the progress of this proficiency testing program, each **participating accreditation body / laboratory is required** to fill in this RECEIPT form upon receipt of samples and fax or email it to:

Department of Standards Malaysia (STANDARDS MALAYSIA)
Century Square, Level 1 & 2,
Blok 2300, Jalan Usahawan,
63000 Cyberjaya,
Selangor, MALAYSIA.
(Attn. Mr. Ahmad Razif Abd Rahim)
Fax No. : 603-83189339
Tel. No. : 603-83191400
E-mail : razif@standardsmalaysia.gov.my

Thank you in advance for your cooperation.

The APLAC – T064 samples were received on: (date)

I hereby acknowledge the receipt of *sample(s) in (intact / damaged**) conditions and (suitable / not suitable**) for laboratory testing.

Comments :
.....
.....
.....

Participating Accreditation Body :

Contact Person :

Email Address :

Fax No. : Phone No. :

Note:
* Number of samples (per box).
** Choose whichever appropriate.

Appendix 6

RESULTS SHEET

Laboratory Code :

Result in mg/l round up to 2 decimal places

Metals	Sample A	Sample B	Uncertainty	Instrumentation Technique
	Result (mg/l)	Result (mg/l)		
Aluminium				
Cadmium				
Chromium (total)				
Copper				
Iron				
Manganese				
Lead				
Nickel				
Zinc				

Signature : Date :

Contact person :

Name of participating lab :

Name of accreditation body :

Email address :

Fax No. : Phone No. :

Appendix 7: Analytical Methods Used by Participants

Description of Methods	Laboratory Number
APHA 3111B, 1995	536, 538
APHA 3111D, 1995	536
APHA D	538
EPA 200.7	513
EPA 6010	549, 571
Std Mthd 3500-Mn:1995	525
SW846-method 6010B	529
TCVN 6177:1996	525
<u>Instrumentation Technique Used:</u>	
AAS	500, 504, 505, 520, 523, 530, 535, 536, 537, 538, 540, 542, 543, 555C, 561, 565, 566, 583, 588, 594, 598
Chrome Azurol s Spectrophotometry	566
Colorimetri	523, 561
ICP	509, 522, 572, 587
ICP-AES	508, 534, 549, 560, 563, 581, 596, 599
ICP-MS	501, 541, 547, 555B, 563, 582A, 590, 591, 593, 596, 597, 598
ICP-OES	501, 503, 507, 510, 516, 519, 526, 547, 555A, 568, 575, 576, 578, 582B, 586, 592
Spectrophotometer Spectrophotometric Method	504, 514, 520, 537, 566, 588
<u>Does laboratory accredited?</u>	
Yes	501, 503, 504, 505, 507, 508, 509, 510, 513, 514, 516, 519, 520, 523, 525, 526, 529, 530, 534, 535, 536, 538, 540, 541, 542, 543, 547, 549, 555, 560, 561, 563, 565, 566, 568, 571, 572, 575, 576, 581, 582, 583, 586, 587, 590, 591, 592, 593, 594, 596, 598, 599
No	500, 522, 537, 578, 588, 597

Appendix 8



APLAC T064: Trace Metals in Water

INTERIM REPORT

Date of issue: 26 September 2008

The APLAC T064 scheme requires the participants to report the quantification (in mg/L) of the following trace metals in water sample – Aluminium, Cadmium, Chromium (total), Copper, Iron, Manganese, Lead, Nickel and Zinc.

Two samples labeled Sample A and Sample B were prepared and dispatched to all participants. A total of 59 laboratories participated and only 57 laboratories submitted their results. The evaluation of results was made via values of z-score. A simple robust z-score formula would be:

$$\text{Z-score} = \frac{\text{Result} - \text{Median}}{\text{Normalised IQR}}$$

The interpretation of z-score would be:

$|z| \leq 2$: **Satisfactory**; $2 < |z| < 3$: **Questionable**; $|z| \geq 3$: **Not satisfactory** *

**Note: Laboratories with z-score greater than 3 (not satisfactory) should conduct investigation and take necessary corrective action.*

Table 1, Table 2 and Table 3 show the reported results and their z-score for Sample A and Sample B while the summary statistics for each sample is tabulated in **Table 4** and **Table 5** respectively.

Please confirm this interim report **NO LATER THAN 30 SEPTEMBER 2008** with your **laboratory code, name of laboratory, email, phone and fax number** as it will be used for sending the final report.

If you have any enquiries regarding the results, please contact:

Ms. Nor Azian bt Abu Samah
Department of Chemistry, MALAYSIA
Fax no : +60379853014
Tel. no : +60379853000
Email : azian@kimia.gov.my / proftest@kimia.gov.my

or

Mr. Ahmad Razif Abd Rahim
Department of Standards Malaysia (STANDARDS MALAYSIA)
Fax no : +60383189339
Tel. no : +60383191400
Email : razif@standardsmalaysia.gov.my

Table 1: Reported results and z-scores for Aluminium, Cadmium and Chromium

Laboratory code	Aluminium (mg/l)				Cadmium (mg/l)				Chromium (total) (mg/l)			
	Sample A	z-score	Sample B	z-score	Sample A	z-score	Sample B	z-score	Sample A	z-score	Sample B	z-score
500	NR	-	0.29	-7.13	0.34	-5.06	0.49	-3.28	0.19	-4.50	0.55	-3.68
501	0.32	1.35	0.70	0.77	0.51	0.67	0.69	0.58	0.29	0.00	0.67	0.00
503	0.28	-0.45	0.66	0.00	0.48	-0.34	0.67	0.19	0.31	0.90	0.70	0.92
504	0.31	0.90	0.63	-0.58	0.55	2.02	0.60	-1.16	0.29	0.00	0.69	0.61
505	0.29	0.00	0.57	-1.73	0.48	-0.34	0.63	-0.58	0.26	-1.35	0.59	-2.45
507	0.262	-1.26	0.597	-1.21	0.457	-1.11	0.616	-0.85	0.317	1.21	0.664	-0.18
508	0.28	-0.45	0.66	0.00	0.47	-0.67	0.65	-0.19	0.29	0.00	0.65	-0.61
509	0.31	0.90	0.69	0.58	0.50	0.34	0.68	0.39	0.31	0.90	0.69	0.61
510	0.262	-1.26	0.592	-1.31	0.513	0.78	0.694	0.66	0.283	-0.31	0.648	-0.67
513	0.33	1.80	0.70	0.77	NR	-	NR	-	NR	-	NR	-
514	NR	-	NR	-	NR	-	NR	-	NR	-	NR	-
516	0.30	0.45	0.69	0.58	0.51	0.67	0.71	0.96	0.30	0.45	0.68	0.31
519	0.2570	-1.48	0.6035	-1.09	0.4493	-1.37	0.6253	-0.67	0.2782	-0.53	0.6293	-1.25
520	0.30	0.45	0.69	0.58	0.84	11.80	0.97	5.97	0.29	0.00	0.41	-7.97
522	0.31	0.90	0.72	1.16	0.47	-0.67	0.65	-0.19	0.30	0.45	0.68	0.31
523	0.31	0.90	0.65	-0.19	0.52	1.01	0.62	-0.77	0.30	0.45	0.69	0.61
525	NR	-	NR	-	NR	-	NR	-	NR	-	NR	-
526	0.29	0.00	0.69	0.58	0.51	0.67	0.70	0.77	0.30	0.45	0.68	0.31
529	0.25	-1.80	0.57	-1.73	0.45	-1.35	0.61	-0.96	0.29	0.00	0.65	-0.61
530	0.43	6.30	0.77	2.12	0.50	0.34	0.68	0.39	0.27	-0.90	0.56	-3.37
534	0.29	0.00	0.66	0.00	0.48	-0.34	0.67	0.19	0.30	0.45	0.65	-0.61
535	NR	-	NR	-	0.46	-1.01	0.64	-0.39	0.29	0.00	0.64	-0.92
536	0.26	-1.35	0.60	-1.16	0.47	-0.67	0.63	-0.58	0.31	0.90	0.68	0.31
537	<0.02	-	<0.02	-	0.50	0.34	0.69	0.58	0.40	4.95	1.04	11.34
538	NR	-	NR	-	0.49	0.00	0.71	0.96	0.37	3.60	0.67	0.00
540	0.31	0.90	0.64	-0.39	NR	-	NR	-	0.24	-2.25	0.53	-4.29
541	0.29	0.00	0.71	0.96	0.59	3.37	0.80	2.70	0.32	1.35	0.74	2.15
542	NR	-	NR	-	0.53	1.35	0.69	0.58	0.30	0.45	0.65	-0.61
543	NR	-	NR	-	0.44	-1.69	0.59	-1.35	0.36	3.15	0.69	0.61
547	0.29	0.00	0.67	0.19	0.48	-0.34	0.66	0.00	0.29	0.00	0.66	-0.31
549	0.29	0.00	0.67	0.19	0.47	-0.67	0.65	-0.19	0.29	0.00	0.66	-0.31
555A	0.28	-0.45	0.65	-0.19	0.49	0.00	0.68	0.39	0.31	0.90	0.69	0.61
555B	0.32	1.35	0.62	-0.77	0.48	-0.34	0.72	1.16	0.28	-0.45	0.71	1.23
555C	NR	-	NR	-	0.50	0.34	0.68	0.39	0.31	0.90	0.69	0.61
560	0.30	0.45	0.68	0.39	0.46	-1.01	0.64	-0.39	0.27	-0.90	0.64	-0.92
561	0.31	0.90	0.67	0.19	0.49	0.00	0.65	-0.19	0.28	-0.45	0.67	0.00
563	0.29	0.00	0.65	-0.19	0.46	-1.01	0.64	-0.39	0.28	-0.45	0.65	-0.61
565	NR	-	NR	-	0.40	-3.04	0.55	-2.12	0.28	-0.45	0.64	-0.92
568	0.27	-0.90	0.61	-0.96	0.44	-1.69	0.60	-1.16	0.27	-0.90	0.61	-1.84
571	0.281	-0.40	0.650	-0.19	0.492	0.07	0.672	0.23	0.299	0.40	0.683	0.40
572	0.24	-2.25	0.56	-1.93	0.44	-1.69	0.62	-0.77	0.28	-0.45	0.64	-0.92
575	0.28	-0.45	0.67	0.19	0.43	-2.02	0.61	-0.96	0.28	-0.45	0.65	-0.61
576	0.29	0.00	0.67	0.19	0.49	0.00	0.68	0.39	0.29	0.00	0.68	0.31
578	0.30	0.45	0.70	0.77	0.50	0.34	0.68	0.39	0.29	0.00	0.67	0.00
581	0.39	4.50	0.73	1.35	0.48	-0.34	0.66	0.00	0.30	0.45	0.70	0.92
582A	0.30	0.45	0.68	0.39	0.50	0.34	0.69	0.58	0.30	0.45	0.68	0.31
582B	0.33	1.80	0.71	0.96	0.51	0.67	0.70	0.77	0.32	1.35	0.72	1.53
583	0.33	1.80	0.47	-3.66	0.50	0.34	0.49	-3.28	0.33	1.80	0.33	-10.42
586	0.27	-0.90	0.62	-0.77	0.50	0.34	0.68	0.39	0.30	0.45	0.67	0.00
587	0.28	-0.45	0.64	-0.39	0.5	0.34	0.67	0.19	0.30	0.45	0.68	0.31
588	1.03	33.27	1.18	10.02	0.40	-3.04	0.56	-1.93	0.60	13.94	NR	-
590	0.23	-2.70	0.53	-2.51	0.40	-3.04	0.55	-2.12	0.22	-3.15	0.50	-5.21
591	0.30	0.45	0.68	0.39	0.51	0.67	0.70	0.77	0.31	0.90	0.69	0.61
592	0.27	-0.90	0.67	0.19	0.51	0.67	0.70	0.77	0.30	0.45	0.68	0.31
593	0.28	-0.45	0.67	0.19	0.50	0.34	0.68	0.39	0.29	0.00	0.68	0.31
594	0.30	0.45	0.62	-0.77	0.46	-1.01	0.64	-0.39	0.25	-1.80	0.66	-0.31
596	0.29	0.00	0.65	-0.19	0.45	-1.35	0.62	-0.77	0.32	1.35	0.72	1.53
597	0.29	0.00	0.65	-0.19	0.47	-0.67	0.62	-0.77	0.27	-0.90	0.61	-1.84
598	0.30	0.45	0.71	0.96	0.49	0.00	0.69	0.58	0.29	0.00	0.69	0.61
599	0.31	0.90	0.70	0.77	0.49	0.00	0.66	0.00	0.29	0.00	0.67	0.00

NR = Not reported

z-scores outside the satisfactory range $|z| \geq 3$, are shown in bold.

Table 2: Reported results and z-scores for Copper, Iron and Manganese

Laboratory code	Copper (mg/l)				Iron (mg/l)				Manganese (mg/l)			
	Sample A	z-score	Sample B	z-score	Sample A	z-score	Sample B	z-score	Sample A	z-score	Sample B	z-score
500	1.00	0.81	1.42	-0.39	0.23	-3.15	0.57	-5.13	0.39	6.92	0.56	3.04
501	0.95	-0.54	1.4	-0.77	0.31	0.45	0.78	0.54	0.30	0.69	0.47	0.00
503	1.01	1.08	1.49	0.96	0.27	-1.35	0.73	-0.81	0.28	-0.69	0.45	-0.67
504	0.97	0.00	1.41	-0.58	0.31	0.45	0.75	-0.27	0.29	0.00	0.46	-0.34
505	1.00	0.81	1.43	-0.19	0.30	0.00	0.73	-0.81	0.30	0.69	0.47	0.00
507	0.884	-2.32	1.280	-3.08	0.332	1.44	0.775	0.40	0.282	-0.55	0.445	-0.84
508	0.95	-0.54	1.44	0.00	0.29	-0.45	0.73	-0.81	0.29	0.00	0.45	-0.67
509	0.99	0.54	1.43	-0.19	0.31	0.45	0.75	-0.27	0.30	0.69	0.47	0.00
510	0.961	-0.24	1.45	0.19	0.293	-0.31	0.730	-0.81	0.286	-0.28	0.458	-0.40
513	NR	-	NR	-	NR	-	NR	-	0.29	0.00	0.48	0.34
514	NR	-	NR	-	NR	-	NR	-	0.0071	-19.57	0.0106	-15.49
516	0.98	0.27	1.5	1.16	0.30	0.00	0.77	0.27	0.305	1.04	0.497	0.91
519	0.9731	0.08	1.4662	0.50	0.2779	-0.99	0.7050	-1.48	0.2779	-0.84	0.4153	-1.84
520	0.98	0.27	1.44	0.00	0.17	-5.85	0.79	0.81	0.29	0.00	0.46	-0.34
522	1.05	2.16	1.56	2.31	0.31	0.45	0.78	0.54	0.29	0.00	0.48	0.34
523	0.98	0.27	1.49	0.96	0.30	0.00	0.75	-0.27	0.29	0.00	0.51	1.35
525	NR	-	NR	-	Under range	-	Under range	-	Under range	-	0.44	-1.01
526	0.99	0.54	1.46	0.39	0.32	0.90	0.78	0.54	0.31	1.38	0.49	0.67
529	0.90	-1.89	1.36	-1.54	0.29	-0.45	0.92	4.32	0.29	0.00	0.46	-0.34
530	0.96	-0.27	1.40	-0.77	0.29	-0.45	0.72	-1.08	0.35	4.15	0.54	2.36
534	0.92	-1.35	1.37	-1.35	0.30	0.00	0.76	0.00	0.30	0.69	0.47	0.00
535	0.92	-1.35	1.39	-0.96	0.42	5.40	0.82	1.62	0.27	-1.38	0.45	-0.67
536	0.99	0.54	1.45	0.19	0.30	0.00	0.74	-0.54	0.28	-0.69	0.49	0.67
537	0.85	-3.24	1.25	-3.66	0.28	-0.90	0.75	-0.27	0.26	-2.08	0.42	-1.69
538	0.57	-10.79	1.48	0.77	0.28	-0.90	0.86	2.70	0.28	-0.69	0.48	0.34
540	0.74	-6.21	1.10	-6.55	0.28	-0.90	0.62	-3.78	NR	-	NR	-
541	1.00	0.81	1.50	1.16	0.18	-5.40	0.94	4.86	0.32	2.08	0.52	1.69
542	0.96	-0.27	1.43	-0.19	0.30	0.00	0.80	1.08	0.30	0.69	0.45	-0.67
543	0.92	-1.35	1.33	-2.12	0.19	-4.95	1.00	6.48	0.06	-15.91	0.26	-7.08
547	0.96	-0.27	1.42	-0.39	0.29	-0.45	0.75	-0.27	0.29	0.00	0.47	0.00
549	0.94	-0.81	1.40	-0.77	0.29	-0.45	0.74	-0.54	0.29	0.00	0.46	-0.34
555A	1.01	1.08	1.51	1.35	0.32	0.90	0.81	1.35	0.31	1.38	0.50	1.01
555B	0.96	-0.27	1.50	1.16	0.30	0.00	0.80	1.08	0.31	1.38	0.52	1.69
555C	0.97	0.00	1.46	0.39	0.32	0.90	0.78	0.54	0.29	0.00	0.46	-0.34
560	0.98	0.27	1.45	0.19	0.27	-1.35	0.70	-1.62	0.27	-1.38	0.45	-0.67
561	0.94	-0.81	1.48	0.77	0.34	1.80	0.78	0.54	0.28	-0.69	0.47	0.00
563	0.93	-1.08	1.37	-1.35	0.29	-0.45	0.72	-1.08	0.29	0.00	0.45	-0.67
565	0.88	-2.43	1.31	-2.51	0.12	-8.09	0.59	-4.59	0.26	-2.08	0.45	-0.67
568	0.96	-0.27	1.41	-0.58	0.32	0.90	0.76	0.00	0.29	0.00	0.46	-0.34
571	0.984	0.38	1.477	0.71	0.300	0.00	0.766	0.16	0.301	0.76	0.484	0.47
572	0.91	-1.62	1.32	-2.31	0.17	-5.85	0.59	-4.59	0.27	-1.38	0.44	-1.01
575	0.97	0.00	1.47	0.58	0.27	-1.35	0.72	-1.08	0.29	0.00	0.45	-0.67
576	0.95	-0.54	1.41	-0.58	0.30	0.00	0.78	0.54	0.30	0.69	0.48	0.34
578	0.98	0.27	1.45	0.19	0.30	0.00	0.77	0.27	0.30	0.69	0.48	0.34
581	0.98	0.27	1.48	0.77	0.31	0.45	0.78	0.54	0.30	0.69	0.49	0.67
582A	0.98	0.27	1.46	0.39	0.31	0.45	0.80	1.08	0.31	1.38	0.49	0.67
582B	1.01	1.08	1.51	1.35	0.30	0.00	0.79	0.81	0.31	1.38	0.50	1.01
583	1.06	2.43	1.05	-7.52	0.33	1.35	0.64	-3.24	0.30	0.69	0.38	-3.04
586	0.93	-1.08	1.4	-0.77	0.30	0.00	0.75	-0.27	0.30	0.69	0.48	0.34
587	0.97	0.00	1.42	-0.39	0.32	0.90	0.78	0.54	0.31	1.38	0.50	1.01
588	0.71	-7.01	1.14	-5.78	0.21	-4.05	0.72	-1.08	1.26	67.10	1.27	26.98
590	0.74	-6.21	1.1	-6.55	0.28	-0.90	0.71	-1.35	0.23	-4.15	0.37	-3.37
591	1.02	1.35	1.54	1.93	0.31	0.45	0.77	0.27	0.31	1.38	0.49	0.67
592	0.95	-0.54	1.44	0.00	0.30	0.00	0.76	0.00	0.30	0.69	0.48	0.34
593	0.97	0.00	1.46	0.39	0.29	-0.45	0.77	0.27	0.30	0.69	0.48	0.34
594	0.93	-1.08	1.43	-0.19	0.18	-5.40	0.64	-3.24	0.26	-2.08	0.42	-1.69
596	0.98	0.27	1.44	0.00	0.32	0.90	0.77	0.27	0.29	0.00	0.47	0.00
597	0.96	-0.27	1.40	-0.77	0.28	-0.90	0.70	-1.62	0.27	-1.38	0.44	-1.01
598	0.97	0.00	1.49	0.96	0.31	0.45	0.79	0.81	0.30	0.69	0.50	1.01
599	0.98	0.27	1.44	0.00	0.31	0.45	0.78	0.54	0.30	0.69	0.47	0.00

NR = Not reported

z-scores outside the satisfactory range $|z| \geq 3$, are shown in bold.

Table 3: Reported results and z-scores for Lead, Nickel and Zinc

Laboratory code	Lead (mg/l)				Nickel (mg/l)				Zinc (mg/l)			
	Sample A	z-score	Sample B	z-score	Sample A	z-score	Sample B	z-score	Sample A	z-score	Sample B	z-score
500	0.23	-11.24	0.65	-7.19	0.46	-0.84	0.94	-0.54	0.32	-3.37	0.61	-3.80
501	0.48	0.00	0.95	-0.45	0.46	-0.84	0.92	-1.08	0.37	-2.25	0.72	-2.45
503	0.47	-0.45	0.94	-0.67	0.50	0.84	0.97	0.27	0.45	-0.45	0.83	-1.10
504	0.49	0.45	1.00	0.67	0.49	0.42	0.91	-1.35	0.47	0.00	0.99	0.86
505	0.47	-0.45	0.96	-0.22	0.45	-1.26	0.92	-1.08	0.50	0.67	1.00	-0.98
507	0.447	-1.48	0.899	-1.60	0.442	-1.60	0.884	-2.05	0.428	-0.94	0.849	-0.87
508	0.47	-0.45	0.94	-0.67	0.47	-0.42	0.94	-0.54	0.45	-0.45	0.91	-0.12
509	0.50	0.90	0.98	0.22	0.49	0.42	0.94	-0.54	0.48	0.22	0.97	0.61
510	0.446	-1.53	0.881	-2.00	0.473	-0.30	0.923	-1.00	0.439	-0.70	0.857	-0.77
513	NR	-	NR	-	0.48	0.00	0.95	-0.27	NR	-	NR	-
514	NR	-	NR	-	NR	-	NR	-	NR	-	NR	-
516	0.48	0.00	0.97	0.00	0.49	0.42	0.98	0.54	0.49	0.45	0.98	0.74
519	0.4492	-1.38	0.9105	-1.34	0.4573	-0.96	0.9119	-1.30	0.4143	-1.25	0.8412	-0.97
520	1.79	58.91	3.62	59.58	0.60	5.06	1.09	3.51	0.63	3.60	1.02	1.23
522	0.49	0.45	0.98	0.22	0.49	0.42	0.98	0.54	0.44	-0.67	0.88	-0.49
523	0.48	0.00	1.02	1.12	0.50	0.84	1.02	1.62	0.50	0.67	1.00	0.98
525	NR	-	NR	-	NR	-	NR	-	NR	-	NR	-
526	0.49	0.45	0.99	0.45	0.50	0.84	0.99	0.81	0.50	0.67	0.98	0.74
529	0.47	-0.45	0.92	-1.12	0.47	-0.42	0.92	-1.08	0.44	-0.67	0.86	-0.74
530	0.50	0.90	1.00	0.67	0.48	0.00	0.96	0.00	0.49	0.45	0.94	0.25
534	0.49	0.45	0.99	0.45	0.47	-0.42	0.94	-0.54	0.47	0.00	0.93	0.12
535	0.39	-4.05	0.76	-4.72	0.38	-4.22	0.81	-4.05	0.47	0.00	0.92	0.00
536	0.48	0.00	0.96	-0.22	0.46	-0.84	0.96	0.00	0.47	0.00	0.92	0.00
537	0.39	-4.05	0.78	-4.27	0.47	-0.42	1.01	1.35	0.46	-0.22	0.88	-0.49
538	0.50	0.90	0.98	0.22	0.47	-0.42	0.98	0.54	0.42	-1.12	0.98	0.74
540	NR	-	NR	-	NR	-	NR	-	0.44	-0.67	0.85	-0.86
541	0.51	1.35	1.02	1.12	0.52	1.69	1.03	1.89	0.40	-1.57	0.87	-0.61
542	0.46	-0.90	0.93	-0.90	0.50	0.84	1.01	1.35	0.51	0.90	1.00	0.98
543	0.37	-4.95	0.93	-0.90	0.42	-2.53	0.93	-0.81	0.16	-6.97	0.41	-6.25
547	0.47	-0.45	0.94	-0.67	0.48	0.00	0.95	-0.27	0.47	0.00	0.92	0.00
549	0.48	0.00	0.96	-0.22	0.47	-0.42	0.95	-0.27	0.47	0.00	0.92	0.00
555A	0.49	0.45	0.97	0.00	0.50	0.84	1.00	1.08	0.49	0.45	0.96	0.49
555B	0.46	-0.90	1.00	0.67	0.43	-2.11	0.96	0.00	0.51	0.90	1.00	0.98
555C	0.49	0.45	0.98	0.22	0.46	-0.84	0.97	0.27	0.47	0.00	0.92	0.00
560	0.50	0.90	0.98	0.22	0.48	0.00	0.93	-0.81	0.44	-0.67	0.90	-0.25
561	0.47	-0.45	1.00	0.67	0.46	-0.84	0.96	0.00	0.47	0.00	0.96	0.49
563	0.46	-0.90	0.93	-0.90	0.46	-0.84	0.94	-0.54	0.42	-1.12	0.81	-1.35
565	0.49	0.45	0.98	0.22	0.37	-4.64	0.83	-3.51	0.49	0.45	0.98	0.74
568	0.49	0.45	0.95	-0.45	0.48	0.00	0.95	-0.27	0.43	-0.90	0.86	-0.74
571	0.486	0.27	0.979	0.20	0.492	0.51	0.996	0.97	0.486	0.36	0.962	0.52
572	0.43	-2.25	0.89	-1.80	0.45	-1.26	0.91	-1.35	0.42	-1.12	0.86	-0.74
575	0.46	-0.90	0.93	-0.90	0.45	-1.26	0.94	-0.54	0.39	-1.80	0.88	-0.49
576	0.49	0.45	0.98	0.22	0.50	0.84	1.01	1.35	0.47	0.00	0.93	0.12
578	0.48	0.00	0.97	0.00	0.49	0.42	0.97	0.27	0.49	0.45	0.97	0.61
581	0.47	-0.45	0.95	-0.45	0.48	0.00	0.96	0.00	0.46	-0.22	0.92	0.00
582A	0.51	1.35	0.97	0.00	0.48	0.00	0.97	0.27	0.48	0.22	0.94	0.25
582B	0.52	1.80	1.02	1.12	0.52	1.69	1.04	2.16	0.50	0.67	0.99	0.86
583	0.48	0.00	0.47	-11.24	0.51	1.26	0.69	-7.28	0.52	1.12	0.76	-1.96
586	0.48	0.00	0.98	0.22	0.48	0.00	0.97	0.27	0.50	0.67	0.98	0.74
587	0.49	0.45	0.99	0.45	0.49	0.42	0.99	0.81	0.51	0.90	0.97	0.61
588	0.34	-6.30	1.06	2.02	0.56	3.37	1.09	3.51	0.43	-0.90	0.78	-1.72
590	0.37	-4.95	0.75	-4.95	0.35	-5.48	0.72	-6.48	0.39	-1.80	0.77	-1.84
591	0.51	1.35	1.01	0.90	0.51	1.26	1.01	1.35	0.52	1.12	0.99	0.86
592	0.49	0.45	0.97	0.00	0.49	0.42	0.97	0.27	0.49	0.45	0.97	0.61
593	0.47	-0.45	0.95	-0.45	0.48	0.00	0.97	0.27	0.48	0.22	0.95	0.37
594	0.43	-2.25	0.92	-1.12	0.57	3.79	1.10	3.78	0.40	-1.57	0.90	-0.25
596	0.51	1.35	1.04	1.57	0.48	0.00	0.96	0.00	0.43	-0.90	0.84	-0.98
597	0.49	0.45	0.96	-0.22	0.43	-2.11	0.85	-2.97	0.49	0.45	0.93	0.12
598	0.47	-0.45	0.97	0.00	0.47	-0.42	0.98	0.54	0.48	0.22	0.97	0.61
599	0.49	0.45	1.00	0.67	0.51	1.26	0.98	0.54	0.50	0.67	0.97	0.61

NR = Not reported

z-scores outside the satisfactory range $|z| \geq 3$, are shown in bold.

Table 4: Summary statistics for Sample A

	SAMPLE A								
	Al	Cd	Cr (Total)	Cu	Fe	Mn	Pb	Ni	Zn
No.of results	50	56	57	57	57	58	56	57	57
Median	0.29	0.49	0.29	0.97	0.30	0.29	0.48	0.48	0.47
IQR	0.03	0.04	0.03	0.05	0.03	0.02	0.03	0.03	0.06
Normalised IQR	0.02	0.03	0.02	0.04	0.02	0.01	0.02	0.02	0.04
Range	0.80	0.50	0.41	0.49	0.30	1.25	1.56	0.25	0.47

Table 5: Summary statistics for Sample B

	SAMPLE B								
	Al	Cd	Cr (Total)	Cu	Fe	Mn	Pb	Ni	Zn
No.of results	51	56	56	57	57	59	56	57	57
Median	0.66	0.66	0.67	1.44	0.76	0.47	0.97	0.96	0.92
IQR	0.07	0.07	0.04	0.07	0.05	0.04	0.06	0.05	0.11
Normalised IQR	0.05	0.05	0.03	0.05	0.04	0.03	0.04	0.04	0.08
Range	0.89	0.48	0.71	0.51	0.43	1.26	3.15	0.41	0.61