Report No. 1034

Waters Proficiency Testing Program

Round No. 212

- Metals -
Chromium, Copper, Iron, Lead, Nickel, Thallium, Zinc

July 2017

Acknowledgments

PTA wishes to gratefully acknowledge the technical assistance provided for this program by Mrs J McGuire, ChemCentre (Australia). Also our thanks go to the Environmental Resource Associates (USA) for the supply of samples and to Global Proficiency Pty Ltd (Australia) for distributing the samples.

PO Box 7507 SILVERWATER NSW 2128, Australia

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CONTENTS

1. Foreword

This report summarises the results of a proficiency testing program on the determination of Chromium, Copper, Iron, Lead, Nickel, Thallium and Zinc in waters. This is round 212 in a planned series of programs involving the analysis of chemical and physical parameters of waters.

The exercise was conducted in May 2017 by Proficiency Testing Australia (PTA). The main aim of the program was to assess laboratories' abilities to competently perform the prescribed analyses.

The Program Coordinator was Mrs D Mihaila and the Technical Adviser was Mrs J McGuire, ChemCentre (Australia). This report was authorised by Mrs F Watton, PTA Quality Manager.

2. Program Features and Design

2.1 Each laboratory was randomly allocated a unique code number for the program to ensure confidentiality of results. Reference to each laboratory in this report is by code number only. Please note that a number of laboratories reported more than one set of results and, therefore, their code numbers (with letter) could appear several times in the same data set.

2.2 Laboratories were provided with the "Instructions to Participants" and "Results Sheet" (see Appendix C). Laboratories were requested to perform the tests according to their routine methods.

2.3 Participants were provided with one sealed vial (labelled R212) containing solutions of Chromium, Copper, Iron, Lead, Nickel, Thallium and Zinc.

2.4 A total of 45 laboratories received samples, comprising:

- 36 Australian participants; and
- 9 overseas participants, including:
    - Brunei Darussalam (1), Indonesia (2), Korea (1), Malaysia (2), Russia (1), Tanzania (1), Thailand (1).

Of these 45 laboratories, one was unable to submit results by the due date.

2.5 Results (as reported by participants) with corresponding summary statistics (i.e. number of results, median, normalised interquartile range, uncertainty of the median, robust coefficient of variation, minimum, maximum and range) are presented in Appendix A (for each of the analyses performed).

2.6 A robust statistical approach, using z-scores, was utilised to assess laboratories' testing performance (see Section 3). Robust z-scores and ordered z-score charts relevant to each test are presented in Appendix A.

The document entitled *Guide to Proficiency Testing Australia,* 2016 (reference [1]) defines the statistical terms and details the statistical procedures referred to in this report.

2.7 A tabulated listing of laboratories (by code number) identified as having outlier results can be found on page 15.

2.8 Prior to sample distribution, a number of randomly selected samples were analysed for homogeneity and stability. Based on the results of this testing (see Appendix B) it was considered that the samples utilised for this program were homogeneous and stable. As such, any results later identified as outliers could not be attributed to any notable sample variability.

3. Statistical Format

For each test, where appropriate, the following information is given:

- a table of results and calculated z-scores;
- a list of summary statistics; and
- ordered z-score charts.

3.1 Outlier Results and Z-scores

In order to assess laboratories' testing performance, a robust statistical approach, using z-scores, was utilised. Z-scores give a measure of how far a result is from the consensus value (i.e. the median), and gives a "score" to each result relative to the other results in the group.

A z-score with an absolute value less than or equal to 2.0 is considered to be satisfactory, whereas, a z-score with an absolute value greater than or equal to 3.0 is considered to be an outlier and is marked by the symbol "§". Laboratories are also encouraged to review results which have an absolute z-score value between 2.0 and 3.0 (i.e. $2.0 < |z\text{-score}| < 3.0$). These are considered to be questionable results.

Each determination was examined for outliers with all methods pooled. The table on page 15 summarises the outlier results detected.

3.2 Results Tables and Summary Statistics

The tables in Appendix A contain the results returned by each laboratory, including the code number for the method used and the robust z-score calculated for each result.

Results have been entered exactly as reported by participants. That is, laboratories which did not report results to the precision (i.e. number of decimal places) requested on the Results Sheet have not been rounded to the requested precision before being included in the statistical analysis.

A list of summary statistics appears at the bottom of each of the results tables and consists of:

- *No. of Results*: the total number of results for that test/sample;
- *Median*: the middle value of the results;
- *Normalised IQR*: the normalised interquartile range of the results;
- *Uncertainty of the Median*: a robust estimate of the standard deviation of the *Median*;
- *Robust CV*: the robust coefficient of variation expressed as a percentage, i.e. 100 x *Normalised IQR* / *Median*;
- *Minimum*: the lowest laboratory result;
- *Maximum*: the highest laboratory result; and
- *Range*: the difference between the *Maximum* and *Minimum*.

The median is a measure of the centre of the data.

The normalised IQR is a measure of the spread of the results. It is calculated by multiplying the interquartile range (IQR) by a correction factor, which converts the IQR to an estimate of the standard deviation. The IQR is the difference between the upper and lower quartiles (i.e. the values above and below which a quarter of the results lie, respectively).

For normally distributed data, the uncertainty of the median is approximated by:

$$\sqrt{\frac{\pi}{2}} \times \frac{normIQR}{\sqrt{n}}$$

n = number of results.

Please see reference [1] for further details on these robust summary statistics.

3.3 Ordered Z-score Charts

The charts in Appendix A indicate each laboratory's robust z-score, in order of magnitude, marked with its laboratory code number. From these charts, each laboratory can readily compare its performance relative to the other laboratories.

These charts contain solid lines at +3.0 and -3.0, so that outliers are clearly identifiable as those laboratories whose "bar" extends beyond these "cut-off" lines. The y-axis of these charts has been limited, so very large z-scores appear to extend beyond the chart boundary.

4. PTA and Technical Adviser's Comments

4.1 Metrological Traceability and Measurement Uncertainty of Assigned Values

Consensus values (median) derived from participants' results are used in this program. These values are not metrologically traceable to an external reference.

Sample preparation was undertaken according to Environmental Resource Associates' Standard Operating Procedures to ensure samples were fit-for-purpose, homogeneous and stable.

Solutions were stable and homogeneous, and medians obtained from this proficiency round were in good agreement with the expected levels (manufacturer's assigned values), as shown in Table 1.

As the assigned value for each analyte in this program is the median of the results submitted by the participants, the uncertainty of the median for each analyte has been calculated and is presented in the Table 1 below.

Table 1. Comparison of expected levels and proficiency medians. The values of the calculated uncertainty of the median are also presented.

Analyte	Expected Levels (µg/L)	Median (µg/L)	Uncertainty of the median (µg/L)
Chromium	439	446.0	2.4
Copper	734	729.0	5.7
Iron	581	594.0	4.5
Lead	650	657.0	5.5
Nickel	1440	1462.0	12.2
Thallium	621	636.0	6.7
Zinc	779	795.0	8.0

Overall, the performance of participants in this round was good, with robust CVs less than 6% for all analytes and comparable to those obtained in previous rounds.

4.2 Analysis of Round 212 Results

4.2.1 Chromium (Cr)

Table 2 compares the Chromium median and robust CV from this round to those obtained in previous PTA rounds.

Table 2. Comparison of current round variability and proficiency median of Chromium testing with the results of the previous two rounds.

Round	Sample	Median (µg/L)	Robust CV (%)	Participants
This study	R212	446.0	2.6	38
Report 962	R191	560.0	5.4	33
Report 917	R179	291.0	5.2	39

Bias / Accuracy

The Chromium testing was successfully performed, with satisfactory results (|z-score| ≤ 2.0) ranging between 425 – 466 µg/L. Out of 38 participants, five questionable results (2.0 < |z-score| < 3.0) were reported (laboratories 213, 283, 432B, 575 and 685). Six outlier results (|z-score| ≥ 3.0) were obtained, requiring follow-up action by laboratories 303, 330, 407A, 579, 603 and 645.

Figure 1 presents the spread of results and the methods used for Chromium testing in this round.

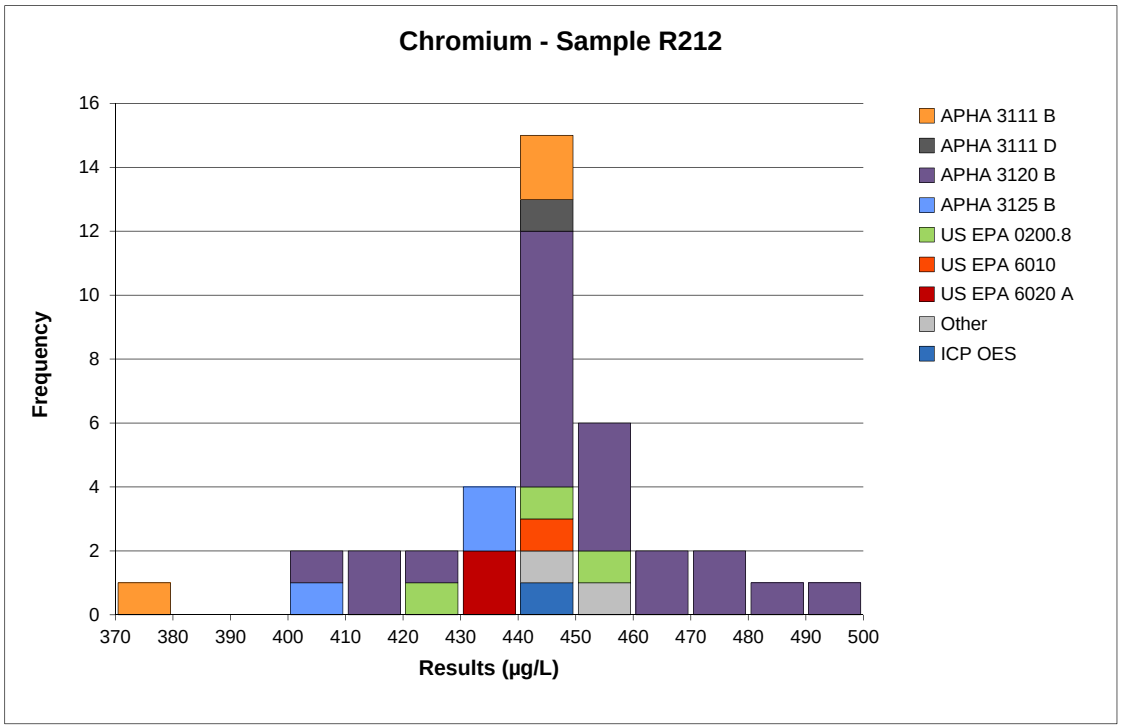


Figure 1. Spread of results for Chromium testing of sample R212, with a median of 446.0 µg/L.

The data set formed an approximately normal distribution with no significant bias attributable to any one method. The majority of participants (58%) used the method APHA 3120 B (Inductively Coupled Plasma / Atomic Emission Spectrometry).

4.2.2 Copper (Cu)

Table 3 compares the Copper median and robust CV from this round to those obtained in previous PTA rounds.

Table 3. Comparison of current round variability and proficiency median of Copper testing with the results of the previous two rounds.

Round	Sample	Median (µg/L)	Robust CV (%)	Participants
This study	R212	729.0	4.0	41
Report 962	R191	373.0	6.5	38
Report 917	R179	714.5	3.4	44

Bias / Accuracy

The Copper testing was successfully performed, with satisfactory results (|z-score| ≤ 2.0) ranging between 689 – 780 µg/L. Out of 41 participants, four questionable results (2.0 < |z-score| < 3.0) were reported (laboratories 332, 526, 579 and 626). One outlier result (|z-score| ≥ 3.0) was obtained, requiring follow-up action by laboratory 407A.

Figure 2 presents the spread of results and the methods used for Copper testing in this round.

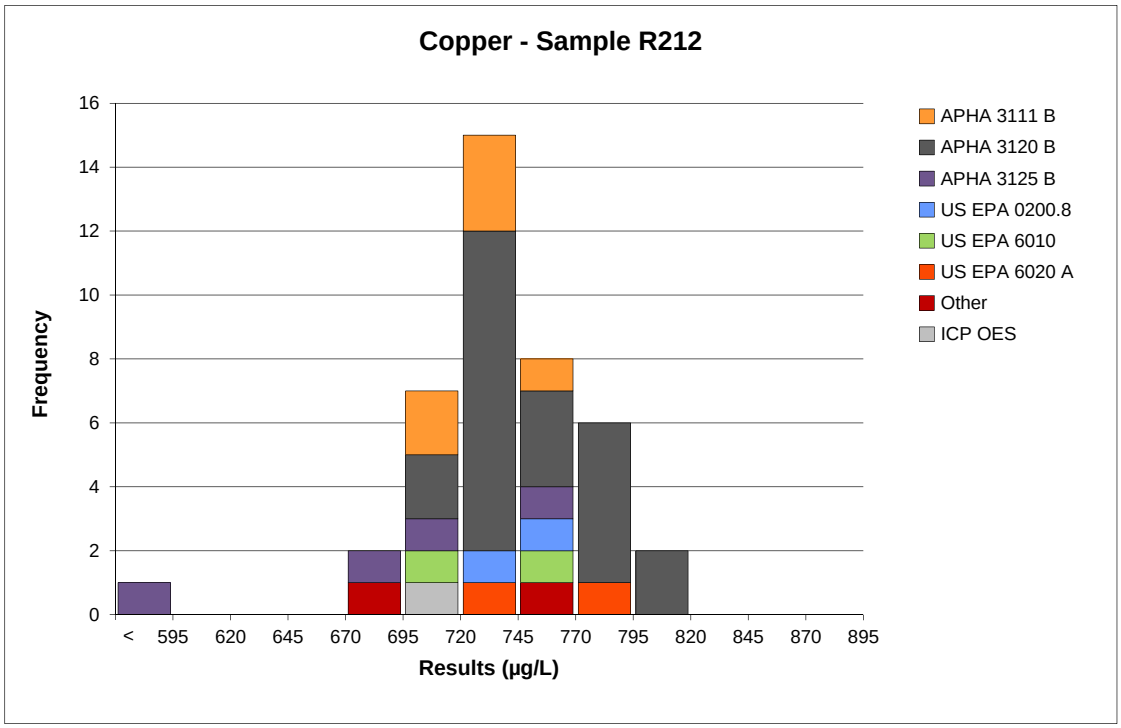


Figure 2. Spread of results for Copper testing of sample R212, with a median of 729.0 µg/L.

The data set formed an approximately normal distribution with no significant bias attributable to any one method. The majority of participants (54%) used the method APHA 3120 B (Inductively Coupled Plasma / Atomic Emission Spectrometry).

4.2.3 Iron (Fe)

Table 4 compares the Iron median and robust CV from this round to those obtained in previous PTA rounds.

Table 4. Comparison of current round variability and proficiency median of Iron testing with the results of the previous two rounds.

Round	Sample	Median (µg/L)	Robust CV (%)	Participants
This study	R212	594.0	4.0	43
Report 962	R191	1900.0	6.0	37
Report 917	R179	357.5	8.5	44

Bias / Accuracy

The Iron testing was successfully performed, with satisfactory results (|z-score| ≤ 2.0) ranging between 550 – 636 µg/L. Out of 43 participants, three questionable results (2.0 < |z-score| < 3.0) were reported (laboratories 283, 303 and 586). Five outlier results (|z-score| ≥ 3.0) were obtained, requiring follow-up action by laboratories 330, 407A, 451, 486 and 579.

Figure 3 presents the spread of results and the methods used for Iron testing in this round.

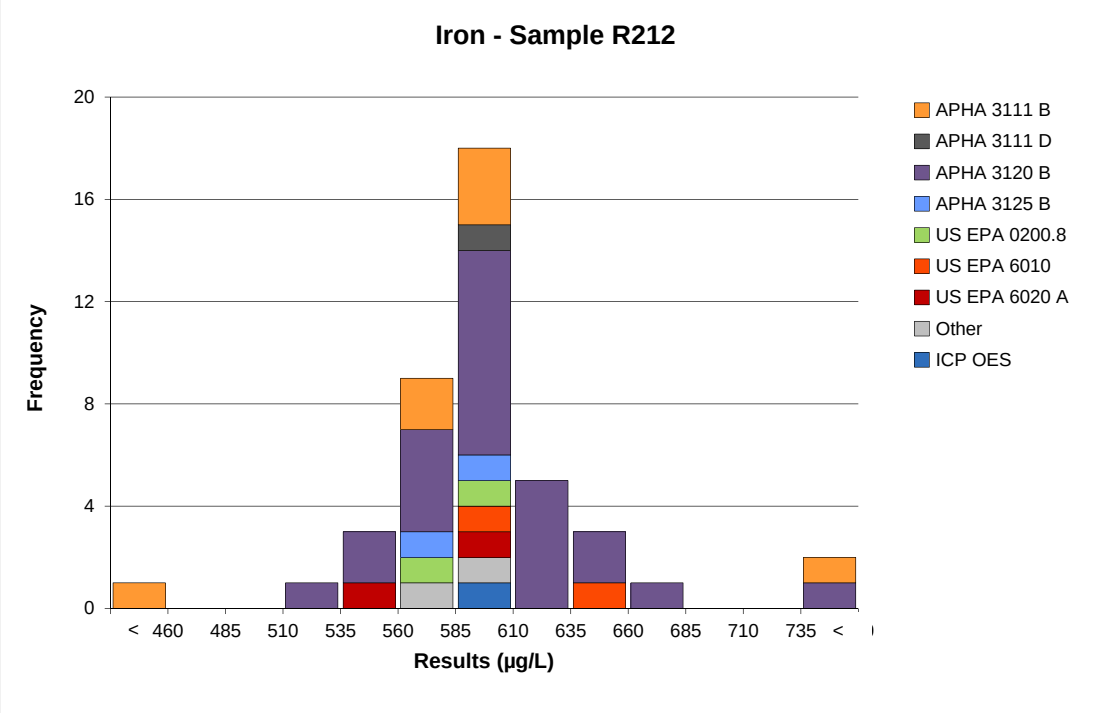


Figure 3. Spread of results for Iron testing of sample R212, with a median of 594.0 µg/L.

The data set formed an approximately normal distribution with no significant bias attributable to any one method. The majority of participants (56%) used the method APHA 3120 B (Inductively Coupled Plasma / Atomic Emission Spectrometry).

4.2.4 Lead (Pb)

Table 5 compares the Lead median and robust CV from this round to those obtained in previous PTA rounds.

Table 5. Comparison of current round variability and proficiency median of Lead testing with the results of the previous two rounds.

Round	Sample	Median (µg/L)	Robust CV (%)	Participants
This study	R212	657.0	4.1	38
Report 962	R191	1195.0	7.4	34
Report 917	R179	554.5	4.0	40

Bias / Accuracy

The Lead testing was successfully performed, with satisfactory results (|z-score| ≤ 2.0) ranging between 604 – 699 µg/L. Out of 38 participants, four questionable results (2.0 < |z-score| < 3.0) were reported (laboratories 283, 359, 432B and 607). Four outlier results (|z-score| ≥ 3.0) were obtained, requiring follow-up action by laboratories 407A, 419, 451 and 579.

Figure 4 presents the spread of results and the methods used for Lead testing in this round.

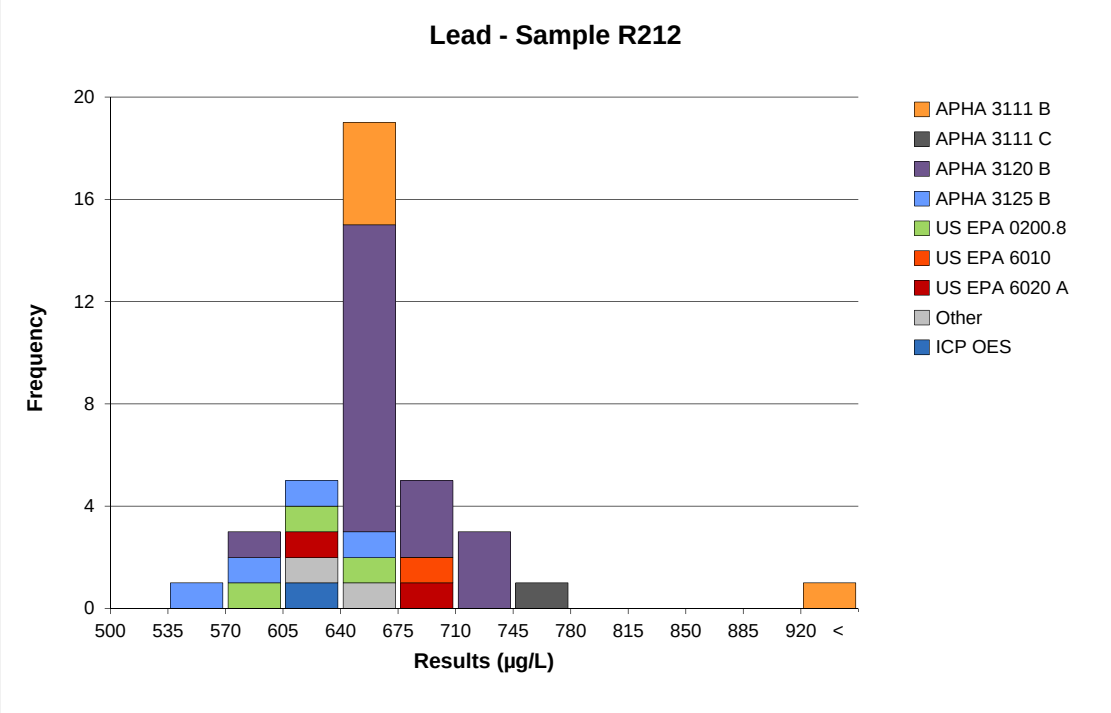


Figure 4. Spread of results for Lead testing of sample R212, with a median of 657.0 µg/L.

The data set formed an approximately normal distribution with no significant bias attributable to any one method. The method most frequently used for Lead testing in this round was APHA 3120 B (Inductively Coupled Plasma / Atomic Emission Spectrometry), which was used by 50% of participants.

4.2.5 Nickel (Ni)

Table 6 compares the Nickel median and robust CV from this round to those obtained in previous PTA rounds.

Table 6. Comparison of current round variability and proficiency median of Nickel testing with the results of the previous two rounds.

Round	Sample	Median (µg/L)	Robust CV (%)	Participants
This study	R212	1462.0	4.1	37
Report 962	R191	1669.5	5.2	34
Report 917	R179	1190.0	4.5	41

Bias / Accuracy

The Nickel testing was successfully performed, with satisfactory results (|z-score| ≤ 2.0) ranging between 1373 – 1580 µg/L. Out of 37 participants, two questionable results (2.0 < |z-score| < 3.0) were reported (laboratories 419 and 603). Three outlier results (|z-score| ≥ 3.0) were obtained, requiring follow-up action by laboratories 407A, 469 and 579.

Figure 5 presents the spread of results and the methods used for Nickel testing in this round.

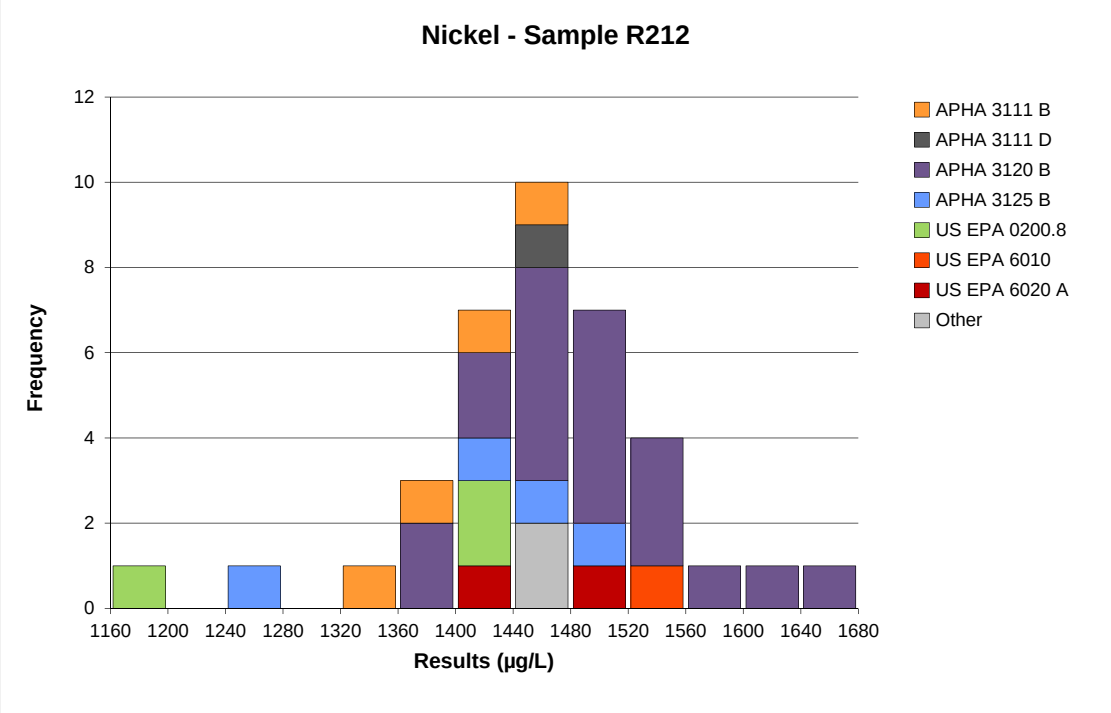


Figure 5. Spread of results for Nickel testing of sample R212, with a median of 1462.0 µg/L.

The data set formed an approximately normal distribution with no significant bias attributable to any one method. The majority of participants (54%) used the method APHA 3120 B (Inductively Coupled Plasma / Atomic Emission Spectrometry).

4.2.6 Thallium (Tl)

Table 7 compares the Thallium median and robust CV from this round to those obtained in previous PTA rounds.

Table 7. Comparison of current round variability and proficiency median of Thallium testing with the results of the previous two rounds.

Round	Sample	Median (µg/L)	Robust CV (%)	Participants
This study	R212	636.0	4.0	23
Report 962	R191	176.0	7.4	24
Report 917	R179	291.0	6.9	25

Bias / Accuracy

The Thallium testing was successfully performed, with satisfactory results (|z-score| ≤ 2.0) ranging between 593 – 662 µg/L. Out of 23 participants, two questionable results (2.0 < |z-score| < 3.0) were reported (laboratories 407A and 603). Four outlier results (|z-score| ≥ 3.0) were obtained, requiring follow-up action by laboratories 213, 359, 579 and 607.

Figure 6 presents the spread of results and the methods used for Thallium testing in this round.

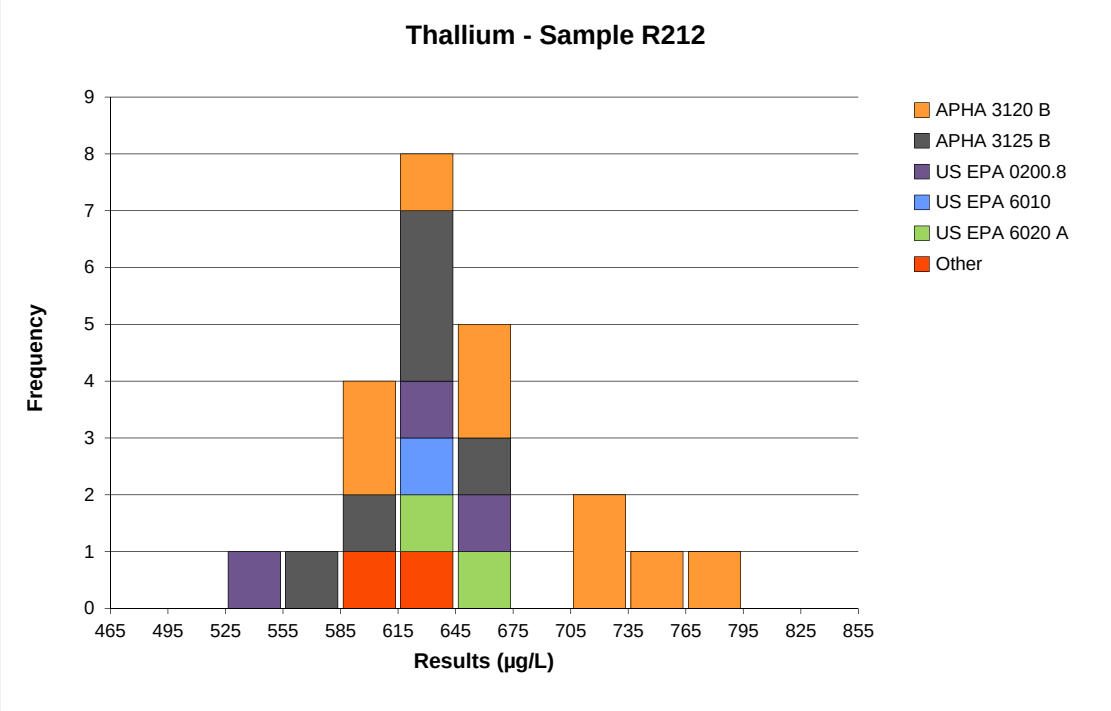


Figure 6. Spread of results for Thallium testing of sample R212, with a median of 636.0 µg/L.

The data set formed an approximately normal distribution with no significant bias attributable to any one method. The method most frequently used for Thallium testing was APHA 3120 B (Inductively Coupled Plasma / Atomic Emission Spectrometry), which was used by approximately 39% of participants.

4.2.7 Zinc (Zn)

Table 8 compares the Zinc median and robust CV from this round to those obtained in previous PTA rounds.

Table 8. Comparison of current round variability and proficiency median of Zinc testing with the results of the previous two rounds.

Round	Sample	Median (µg/L)	Robust CV (%)	Participants
This study	R212	795.0	5.3	43
Report 962	R191	1474.0	6.0	39
Report 917	R179	1249.0	6.1	44

Bias / Accuracy

The Zinc testing was successfully performed, with satisfactory results (|z-score| ≤ 2.0) ranging between 714 – 856 µg/L. Out of 43 participants, two questionable results (2.0 < |z-score| < 3.0) were reported (laboratories 283 and 603). Four outlier results (|z-score| ≥ 3.0) were obtained, requiring follow-up action by laboratories 160, 359, 407A and 579.

Figure 7 presents the spread of results and the methods used for Zinc testing in this round.

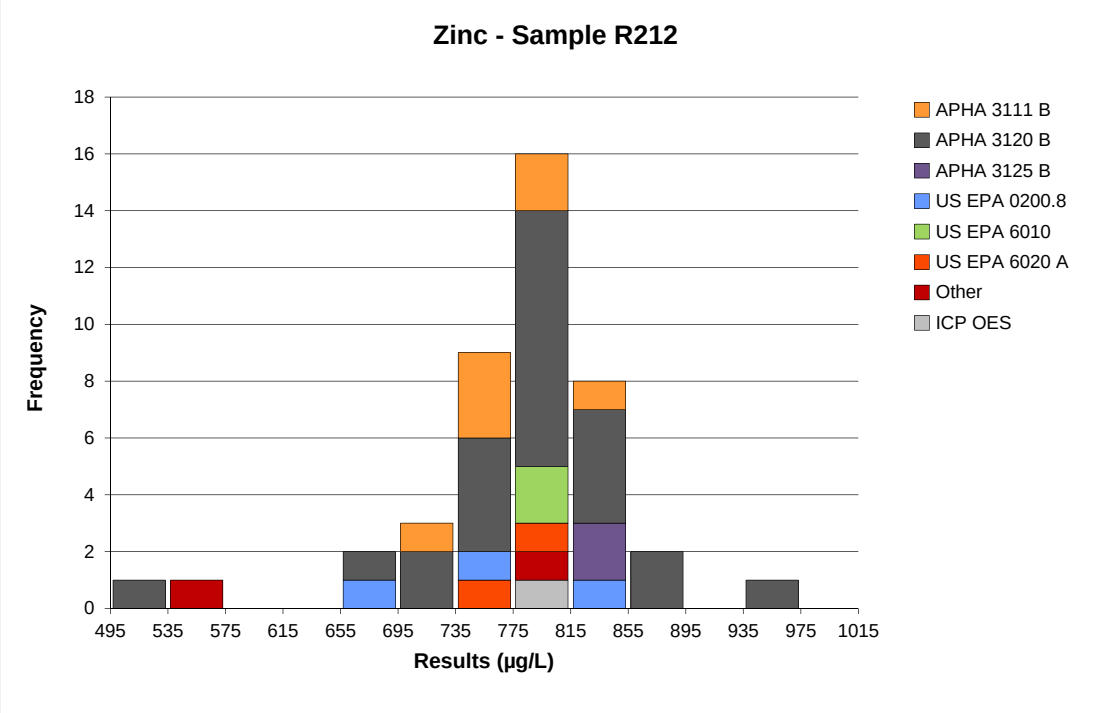


Figure 7. Spread of results for Zinc testing of sample R212, with a median of 795.0 µg/L.

The data set formed an approximately normal distribution with no significant bias attributable to any one method. The majority of participants (56%) used the method APHA 3120 B (Inductively Coupled Plasma / Atomic Emission Spectrometry).

4.3 Measurement Uncertainty (MU)

The majority of participants in this round (74%-83%) reported the measurement uncertainty (MU) associated with their results. Table 9 below presents the number and percentage of laboratories reporting the MU for each analyte.

Table 9. The number and percentage of laboratories reporting MU for analytes in round 212

Analyte	Total participants	Participants reporting MU (percentage)
Chromium	38	30 (79%)
Copper	41	31 (76%)
Iron	43	32 (74%)
Lead	38	31 (82%)
Nickel	37	29 (78%)
Thallium	23	19 (83%)
Zinc	43	32 (74%)

Many of the stated MUs did not accurately reflect the difference between the median and the participant's result for this proficiency sample.

Some laboratories may have notably underestimated their MU, as they indicated that their MU was less than two times the uncertainty of the median, however, their results were further from the median than this value.

Conversely, laboratories which indicated a MU which was greater than three times the normalised IQR may have over-estimated their MU.[1]

[1] MU evaluation is based on minimum / maximum uncertainty criteria (u_{min} and u_{max}) described in ISO 13528:2015 [2]. It should be noted, however, that these are informative indicators only and cannot be solely used to validate or invalidate the MUs reported.

4.4 Analysis of Results by Method Groups

Further analysis of results by method groups is undertaken to provide specific information on individual method performance.

In order for methods to be grouped for analysis, PTA requires at least 11 sets of results from the same method group. For methods and analytes other than those presented below, there were less than 11 results submitted, therefore reliable conclusions cannot be drawn from analysing them separately on this occasion.

The majority of the participant laboratories in this round (79.1%-95.7%) used either ICP/AES (Inductively Coupled Plasma / Atomic Emission Spectrometry) or ICP/MS (Inductively Coupled Plasma / Mass Spectrometry) techniques compared to AAS (Atomic Absorption Spectrometry) technique, which shows the advantage of multi elemental technique over single elemental.

The methods used in this round suggest the preference for more recent techniques. Thus, none of the participating laboratories used the APHA Method 3111 E, (method code 4), APHA Electrothermal AAS (APHA 3113 B, method code 5) or US EPA 0200.9 GFAA (method code 10). Very few laboratories used the APHA Methods 3111 C and D (method codes 2 and 3).

The method APHA 3120 B (ICP/AES) - Method code 6, was most frequently employed for all analytes and the statistical analyses of the results from this method are outlined in Table 10 below. The results for Thallium are not shown, as there were insufficient reported results to conduct an accurate statistical analysis.

Table 10. Variability and proficiency medians of results obtained by method 6 in Round 212.

Analysis	**Method code**	**Participants**	**Median ± Uncertainty of the Median (µg/L)**	**Robust CV (%)**
Chromium	6	22	449.5 ± 4.0	3.3
Copper	6	22	733.5 ± 9.7	4.9
Iron	6	24	600.5 ± 7.6	4.9
Lead	6	19	657.0 ± 8.2	4.3
Nickel	6	20	1495.0 ± 17.8	4.3
Zinc	6	24	794.0 ± 13.0	6.4

In all cases there was an increase in the variability of results when analysed exclusively by APHA 3120 B ICP/AES method.

Three laboratories indicated the use of other methods than those listed in the Instructions to Participants. These laboratories specified their choice method as follows:

- laboratory 160 used an ICP/MS method for Thallium and an ICP method for all other metals;
- laboratory 251 indicated an ICP/OES method for all elements tested;
- laboratory 464 used the GOST 31870-2012 method for all analytes.

Most of the digestion methods involved nitric acid or a combination of nitric and hydrochloric acid. Three laboratories used the microwave in the digestion process. It is worth noting that, from the results reported, there is no notable difference between the non-digestion and various digestion methods, most of the laboratories being able to demonstrate competency in controlling the problems of contamination and loss of analyte during the process.

5. Outlier Results

Laboratories reporting results that have been identified as outliers are listed in Table 11 below.

Table 11. Laboratory results identified as outliers for each analysis performed.

Lab Code	Analysis						
	Chromium	Copper	Iron	Lead	Nickel	Thallium	Zinc
160							§
213						§	
303	§						
330	§		§				
359						§	§
407A	§	§	§	§	§		§
419				§			
451			§	§			
469					§		
486			§				
579	§		§	§	§	§	§
603	§						
607						§	
645	§						

Note:

1. A "**§**" indicates the occurrence of a z-score outlier result (i.e. those results for which |z-score| ≥ 3.0).

6. References

[1] *Guide to Proficiency Testing Australia*, 2016 (This document can be found on the PTA website, www.pta.asn.au).

[2] ISO 13528:2015 *Statistical methods for use in proficiency testing by interlaboratory comparisons.*

APPENDIX A

Results and Data Analysis

Chromium (Cr)
Results

Sample R212

Chromium (Cr)

Results by Laboratory Code

Laboratory Code	Sample R212						
	Result	±	MU[1]	Robust z-score[2]		Method Code[3]	Digestion Code[3]
	µg/L						
103	444	±	11	-0.17		6	#
160	441		#	-0.43		13	24
213	471	±	78	2.14		6	15
230	446	±	12	0.00		6	14
233	444	±	52	-0.17		6	#
251	450		#	0.34		#	#
283	412		#	-2.91		6	15
294	440	±	20	-0.51		12	23
303	411	±	21	-3.00	**§**	6	#
317	446	±	170	0.00		6	#
330	380		#	-5.65	**§**	1	14
345	435	±	15.4	-0.94		7	14
356	443	±	20	-0.26		3	14
359	425	±	64	-1.80		9	24
381	435	±	94	-0.94		12	22
407A	408	±	16	-3.25	**§**	7	14
419	446	±	54	0.00		1	14
432B	476	±	9	2.57		6	#
445	437	±	50	-0.77		7	14
464	451	±	26	0.43		13	14
469	452	±	45	0.51		9	#
473	449	±	45	0.26		9	24
486	449		#	0.26		6	15
490	460	±	15	1.20		6	14
526	466	±	93	1.71		6	#
553	444	±	31	-0.17		1	14
561	446	±	8	0.00		11	#
575	421	±	37	-2.14		6	14
579	498	±	5	4.45	**§**	6	14

[1] Where reported, results are shown with their corresponding measurement uncertainty (MU).

[2] "**§**" denotes an outlier (i.e. those results for which |*z-score*| ≥ 3.0). Robust *z-scores* are calculated *as:* $z = (A - median) \div normalised\ IQR$, where *A* is the participant laboratory's result.

[3] Please refer to Appendix C (pages C3-C4) for method and digestion code descriptions.

Chromium (Cr) - cont.

Results by Laboratory Code

Laboratory Code	Sample R212					
	Result ± µg/L	MU[1]	Robust z-score[2]		Method Code[3]	Digestion Code[3]
586	458 ±	19	1.03		6	14
590	455	#	0.77		6	15
603	485	#	3.34	**§**	6	#
607	447 ±	50	0.09		6	#
622	454 ±	11	0.69		6	15
626	450	#	0.34		6	#
645	403 ±	49	-3.68	**§**	6	14
646	446 ±	27	0.00		6	#
685	470 ±	21	2.06		6	20

No of Results:	38
Median:	446.0
Normalised IQR:	11.7
Uncertainty of the Median:	2.4
Robust CV:	2.6%
Minimum:	380
Maximum:	498
Range:	118

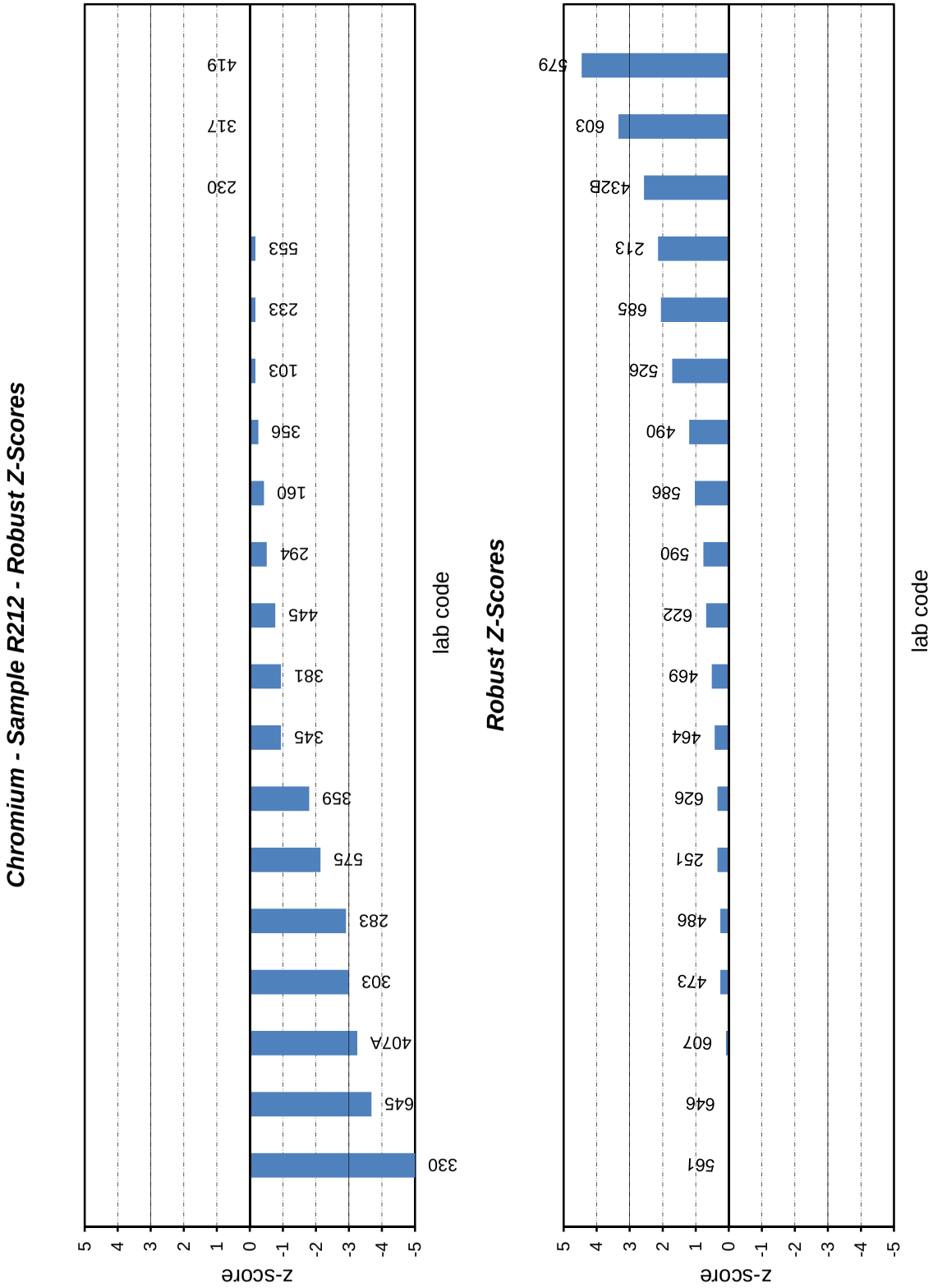
[1] Where reported, results are shown with their corresponding measurement uncertainty (MU).

[2] "**§**" denotes an outlier (i.e. those results for which |*z-score*| ≥ 3.0). Robust *z-scores* are calculated *as:* $z = (A - median) \div normalised\ IQR$, where *A* is the participant laboratory's result.

[3] Please refer to Appendix C (pages C3-C4) for method and digestion code descriptions.

Chromium - Sample R212

Ordered Robust Z-Score Charts



Copper (Cu)
Results

Sample R212

Copper (Cu)

Results by Laboratory Code

Laboratory Code	Sample R212						
	Result	±	MU[1]	Robust z-score[2]		Method Code[3]	Digestion Code[3]
	µg/L						
103	726	±	17	-0.10		6	#
105	715		#	-0.48		1	14
160	690		#	-1.35		13	24
213	735	±	34	0.21		6	15
230	726	±	17.2	-0.10		6	14
233	726	±	54	-0.10		6	#
251	700		#	-1.00		#	#
283	725		#	-0.14		6	15
294	780	±	40	1.76		12	23
303	731	±	37	0.07		6	#
312B	718		#	-0.38		11	24
317	722	±	206	-0.24		6	#
330	759	±	24.6	1.04		1	14
332	800		#	2.46		6	23
345	759	±	26.2	1.04		7	14
350	722	±	51	-0.24		1	14
356	743	±	20	0.48		1	14
359	719	±	158	-0.35		6	24
381	722	±	159	-0.24		12	22
407A	356	±	14	-12.90	**§**	7	14
419	707	±	71	-0.76		1	14
432B	727	±	9	-0.07		6	#
445	707	±	75	-0.76		7	14
464	761	±	39	1.11		13	14
469	770	±	77	1.42		9	#
473	722	±	73	-0.24		9	24
486	724		#	-0.17		6	15
490	760	±	76	1.07		6	14
526	793	±	159	2.21		6	#

[1] Where reported, results are shown with their corresponding measurement uncertainty (MU).

[2] "**§**" denotes an outlier (i.e. those results for which |*z-score*| ≥ 3.0). Robust *z-scores* are calculated *as:* $z = (A - median) \div normalised\ IQR$, where *A* is the participant laboratory's result.

[3] Please refer to Appendix C (pages C3-C4) for method and digestion code descriptions.

Copper (Cu) - cont.

Results by Laboratory Code

Laboratory Code	Sample R212					
	Result ± µg/L		MU[1]	Robust z-score[2]	Method Code[3]	Digestion Code[3]
553	729	±	42	0.00	1	14
561	749	±	12	0.69	11	#
575	689	±	33	-1.38	7	14
579	790	±	7	2.11	6	14
586	767	±	23	1.31	6	14
590	710		#	-0.66	6	15
603	774		#	1.56	6	#
607	775	±	80	1.59	6	#
622	732	±	18	0.10	6	15
626	810		#	2.80	6	#
646	750	±	62	0.73	6	#
685	780	±	73	1.76	6	20

No of Results:	41
Median:	729.0
Normalised IQR:	28.9
Uncertainty of the Median:	5.7
Robust CV:	4.0%
Minimum:	356
Maximum:	810
Range:	454

[1] Where reported, results are shown with their corresponding measurement uncertainty (MU).

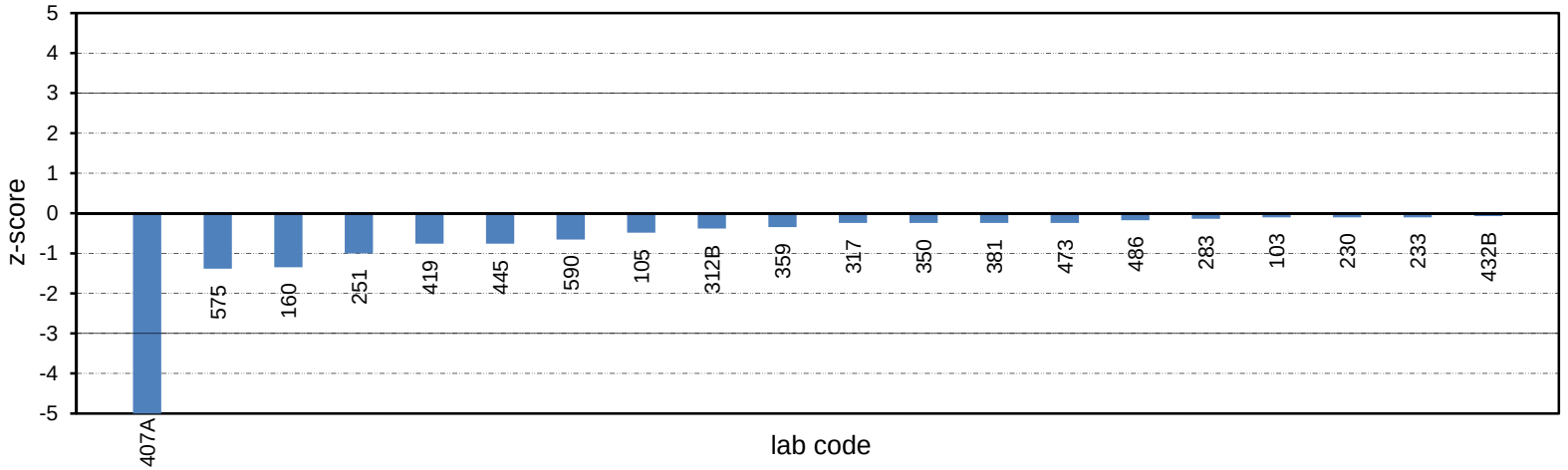
[2] "**§**" denotes an outlier (i.e. those results for which |*z-score*| ≥ 3.0). Robust *z-scores* are calculated *as:* $z = (A - median) \div normalised\ IQR$, where *A* is the participant laboratory's result.

[3] Please refer to Appendix C (pages C3-C4) for method and digestion code descriptions.

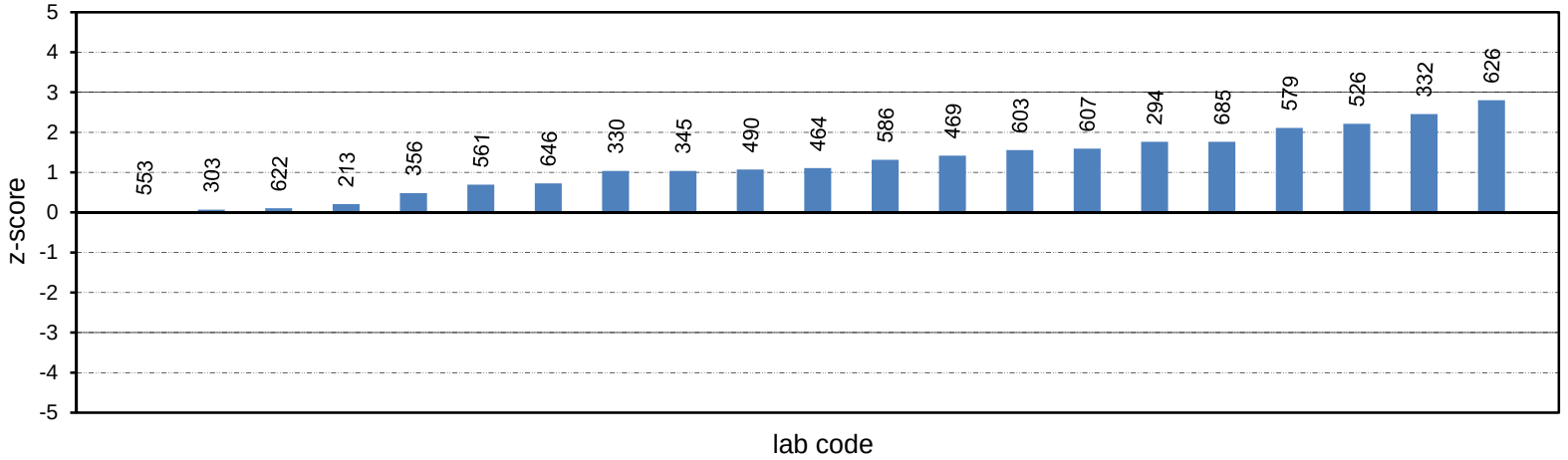
Copper - Sample R212

Ordered Robust Z-Score Charts

Copper - Sample R212 - Robust Z-Scores



Robust Z-Scores



Iron (Fe)
Results

Sample R212

Iron (Fe)

Results by Laboratory Code

Laboratory Code	Sample R212						
	Result	±	MU[1]	Robust z-score[2]		Method Code[3]	Digestion Code[3]
	µg/L						
103	588	±	15	-0.25		6	#
105	583		#	-0.46		1	14
160	562		#	-1.35		13	24
213	625	±	65	1.31		6	15
230	610	±	16.8	0.67		6	14
233	591	±	60	-0.13		6	#
251	592		#	-0.08		#	#
283	539		#	-2.32		6	15
294	590	±	30	-0.17		12	23
303	656	±	33	2.61		6	#
312B	636		#	1.77		11	24
317	595	±	137	0.04		6	#
330	434		#	-6.74	**§**	1	14
332	624		#	1.26		6	23
345	610	±	25.9	0.67		7	14
350	610	±	132	0.67		1	14
356	589	±	20	-0.21		3	14
359	568	±	108	-1.10		6	24
381	551	±	114	-1.81		12	22
407A	1413	±	56	34.53	**§**	6	14
409	600	±	100	0.25		1	#
419	583	±	44	-0.46		1	14
432B	581	±	25	-0.55		6	#
445	583	±	60	-0.46		7	14
451	830	±	50	9.95	**§**	1	#
464	602	±	48	0.34		13	14
469	589	±	59	-0.21		9	#
473	571	±	78	-0.97		9	24
486	515		#	-3.33	**§**	6	15

[1] Where reported, results are shown with their corresponding measurement uncertainty (MU).

[2] "**§**" denotes an outlier (i.e. those results for which |*z-score*| ≥ 3.0). Robust *z-scores* are calculated *as:* $z = (A - median) \div normalised\ IQR$, where *A* is the participant laboratory's result.

[3] Please refer to Appendix C (pages C3-C4) for method and digestion code descriptions.

Iron (Fe) - cont.

Results by Laboratory Code

Laboratory Code	Sample R212						
	Result	±	MU[1]	Robust z-score[2]		Method Code[3]	Digestion Code[3]
	µg/L						
490	620	±	143	1.10		6	14
526	598	±	120	0.17		6	#
553	604	±	32	0.42		1	14
561	594	±	9	0.00		11	#
575	603	±	67	0.38		6	14
579	680	±	4	3.63	**§**	6	14
586	650	±	18	2.36		6	14
590	550		#	-1.85		6	15
603	585		#	-0.38		6	#
607	620	±	65	1.10		6	#
622	582	±	15	-0.51		6	15
626	627		#	1.39		6	#
646	590	±	29	-0.17		6	#
685	610	±	28	0.67		6	20

No of Results:	43
Median:	594.0
Normalised IQR:	23.7
Uncertainty of the Median:	4.5
Robust CV:	4.0%
Minimum:	434
Maximum:	1413
Range:	979

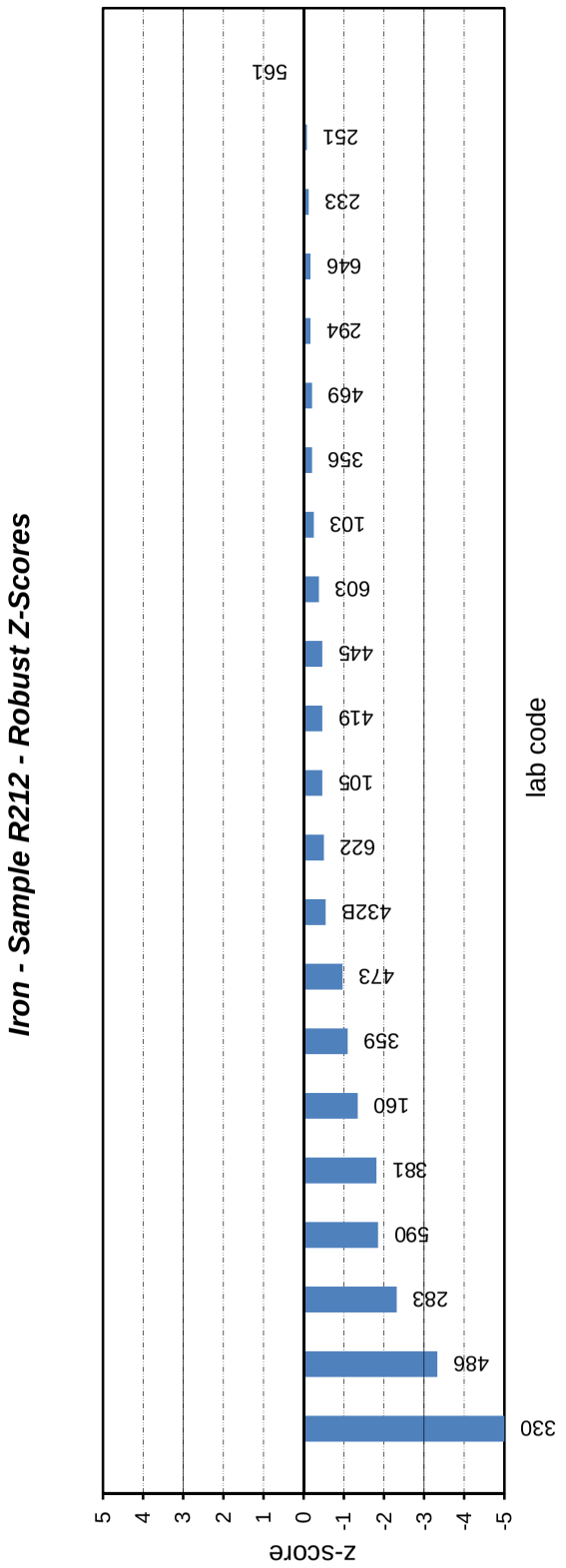
[1] Where reported, results are shown with their corresponding measurement uncertainty (MU).

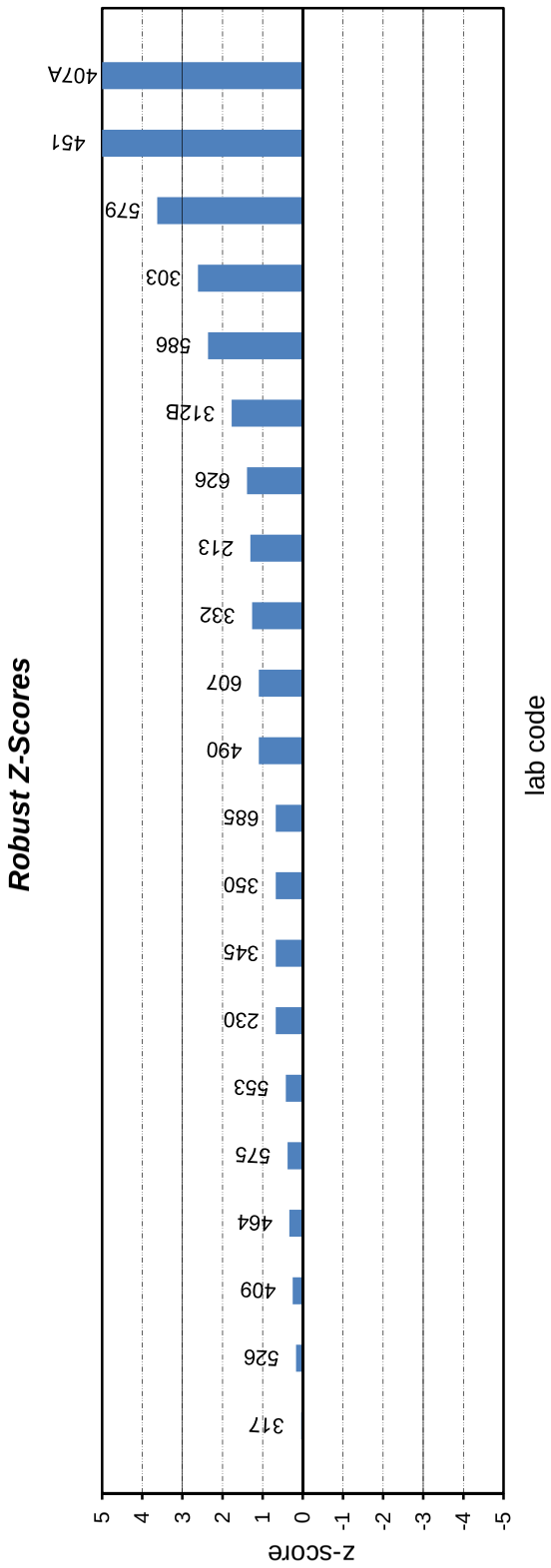
[2] "**§**" denotes an outlier (i.e. those results for which |*z-score*| ≥ 3.0). Robust *z-scores* are calculated *as:* $z = (A - median) \div normalised\ IQR$, where *A* is the participant laboratory's result.

[3] Please refer to Appendix C (pages C3-C4) for method and digestion code descriptions.

Iron - Sample R212

Ordered Robust Z-Score Charts





SD 9.17.11

Lead (Pb)
Results

Sample R212

Lead (Pb)

Results by Laboratory Code

Laboratory Code	Sample R212						
	Result	±	MU[1]	Robust z-score[2]		Method Code[3]	Digestion Code[3]
	µg/L						
103	654	±	16	-0.11		6	#
160	616		#	-1.53		13	24
213	657	±	131	0.00		6	15
230	641	±	15.2	-0.60		6	14
233	656	±	52	-0.04		6	#
251	616		#	-1.53		#	#
283	591		#	-2.46		6	15
294	690	±	40	1.23		12	23
303	654	±	33	-0.11		6	#
317	647	±	139	-0.37		6	#
330	654	±	31.8	-0.11		1	14
345	660	±	27.5	0.11		7	14
350	670	±	215	0.48		1	14
356	657	±	20	0.00		1	14
359	587	±	112	-2.60		9	24
381	634	±	131	-0.86		12	22
407A	537	±	13	-4.47	**§**	7	14
419	1024	±	148	13.66	**§**	1	14
432B	722	±	31	2.42		6	#
445	621	±	65	-1.34		7	14
451	763	±	50	3.94	**§**	2	#
464	667	±	43	0.37		13	14
469	670	±	67	0.48		9	#
473	640	±	79	-0.63		9	24
486	649		#	-0.30		6	15
490	690	±	40	1.23		6	14
526	661	±	132	0.15		6	#
553	668	±	42	0.41		1	14
561	681	±	10	0.89		11	#

[1] Where reported, results are shown with their corresponding measurement uncertainty (MU).

[2] "**§**" denotes an outlier (i.e. those results for which |*z-score*| ≥ 3.0). Robust *z-scores* are calculated *as:* $z = (A - median) \div normalised\ IQR$, where *A* is the participant laboratory's result.

[3] Please refer to Appendix C (pages C3-C4) for method and digestion code descriptions.

Lead (Pb) - cont.

Results by Laboratory Code

Laboratory Code	Sample R212						
	Result	±	MU[1]	Robust z-score[2]		Method Code[3]	Digestion Code[3]
	µg/L						
575	604	±	21	-1.97		7	14
579	743	±	4	3.20	**§**	6	14
586	671	±	20	0.52		6	14
590	655		#	-0.07		6	15
603	699		#	1.56		6	#
607	734	±	75	2.87		6	#
622	646	±	6	-0.41		6	15
626	660		#	0.11		6	#
685	690	±	49	1.23		6	20

No of Results:	38
Median:	657.0
Normalised IQR:	26.9
Uncertainty of the Median:	5.5
Robust CV:	4.1%
Minimum:	537
Maximum:	1024
Range:	487

[1] Where reported, results are shown with their corresponding measurement uncertainty (MU).

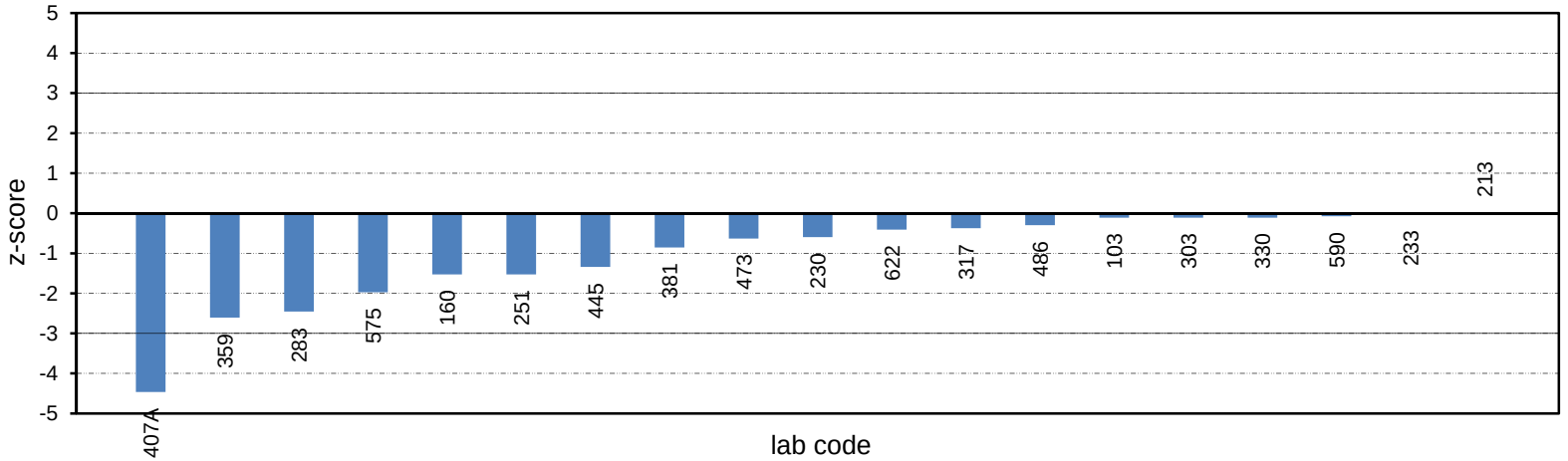
[2] "**§**" denotes an outlier (i.e. those results for which |*z-score*| ≥ 3.0). Robust *z-scores* are calculated *as:* $z = (A - median) \div normalised\ IQR$, where *A* is the participant laboratory's result.

[3] Please refer to Appendix C (pages C3-C4) for method and digestion code descriptions.

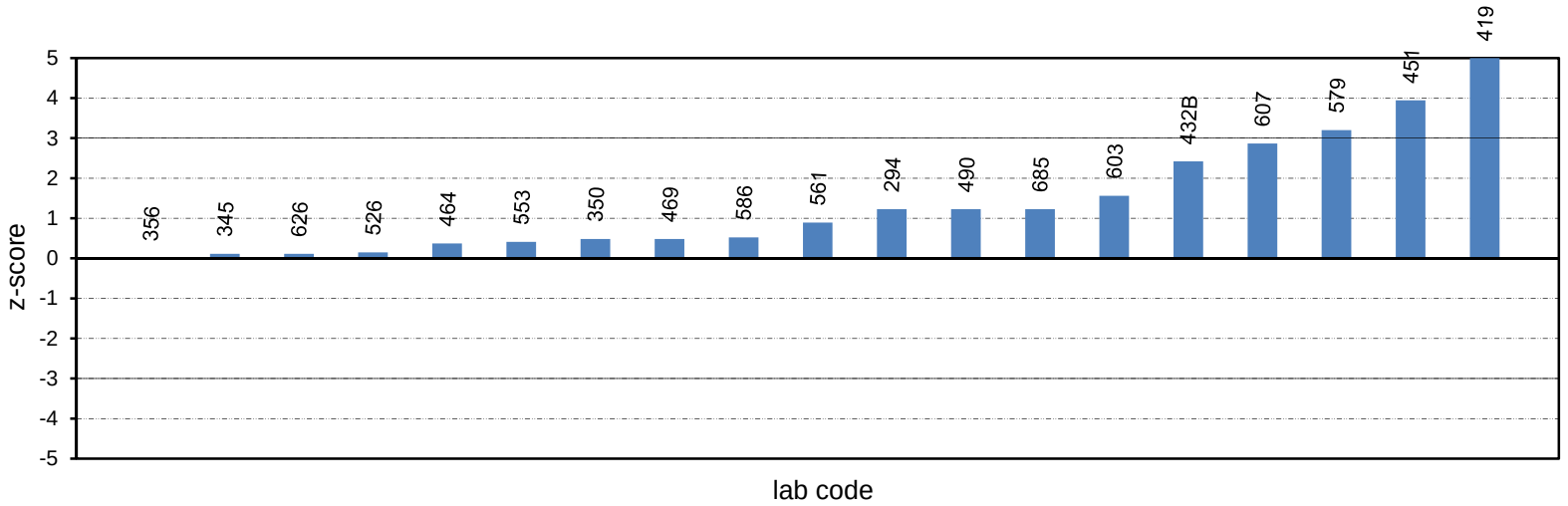
Lead - Sample R212

Ordered Robust Z-Score Charts

Lead - Sample R212 - Robust Z-Scores



Robust Z-Scores



Nickel (Ni)
Results

Sample R212

Nickel (Ni)

Results by Laboratory Code

Laboratory Code	Sample R212						
	Result	±	MU[1]	Robust z-score[2]		Method Code[3]	Digestion Code[3]
	µg/L						
103	1442	±	36	-0.34		6	#
105	1452		#	-0.17		1	14
160	1444		#	-0.30		13	24
213	1400	±	88	-1.05		6	15
230	1490	±	14.8	0.47		6	14
233	1430	±	55	-0.54		6	#
283	1373		#	-1.50		6	15
294	1500	±	100	0.64		12	23
303	1520	±	76	0.98		6	#
317	1446	±	616	-0.27		6	#
330	1400		#	-1.05		1	14
345	1510	±	63.4	0.81		7	14
356	1447	±	50	-0.25		3	14
359	1415	±	198	-0.79		9	24
381	1423	±	214	-0.66		12	22
407A	1264	±	63	-3.34	**§**	7	14
419	1327	±	276	-2.28		1	14
432B	1533	±	9	1.20		6	#
445	1436	±	100	-0.44		7	14
464	1462	±	82	0.00		13	14
469	1200	±	120	-4.42	**§**	9	#
473	1432	±	169	-0.51		9	24
486	1469		#	0.12		6	15
490	1500	±	105	0.64		6	14
526	1520	±	304	0.98		6	#
553	1420	±	72	-0.71		1	14
561	1552	±	30	1.52		11	#
575	1480	±	60	0.30		7	14
579	1678	±	7	3.64	**§**	6	14

[1] Where reported, results are shown with their corresponding measurement uncertainty (MU).

[2] "**§**" denotes an outlier (i.e. those results for which |*z-score*| ≥ 3.0). Robust *z-scores* are calculated *as:* $z = (A - median) \div normalised\ IQR$, where *A* is the participant laboratory's result.

[3] Please refer to Appendix C (pages C3-C4) for method and digestion code descriptions.

Nickel (Ni) - cont.

Results by Laboratory Code

Laboratory Code	Sample R212					
	Result ± µg/L		MU[1]	Robust z-score[2]	Method Code[3]	Digestion Code[3]
586	1534	±	47	1.21	6	14
590	1480		#	0.30	6	15
603	1615		#	2.58	6	#
607	1530	±	160	1.15	6	#
622	1437	±	36	-0.42	6	15
626	1580		#	1.99	6	#
646	1470	±	88	0.13	6	#
685	1500	±	46	0.64	6	20

No of Results:	37
Median:	1462.0
Normalised IQR:	59.3
Uncertainty of the Median:	12.2
Robust CV:	4.1%
Minimum:	1200
Maximum:	1678
Range:	478

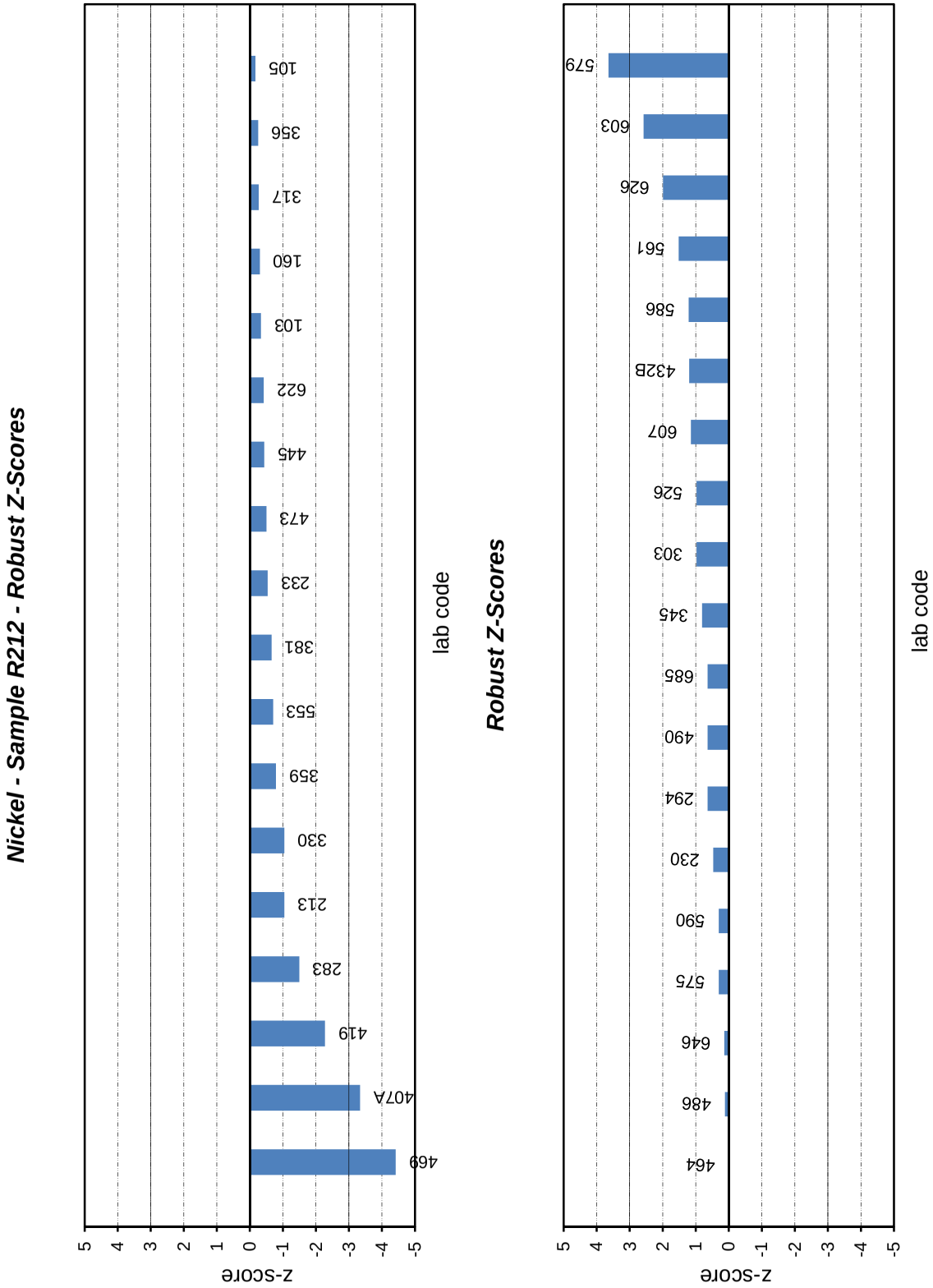
[1] Where reported, results are shown with their corresponding measurement uncertainty (MU).

[2] "**§**" denotes an outlier (i.e. those results for which |*z-score*| ≥ 3.0). Robust *z-scores* are calculated *as:* $z = (A - median) \div normalised\ IQR$, where *A* is the participant laboratory's result.

[3] Please refer to Appendix C (pages C3-C4) for method and digestion code descriptions.

Nickel - Sample R212

Ordered Robust Z-Score Charts



SD 9.17.11

Thallium (Tl)
Results

Sample R212

Thallium (Tl)

Results by Laboratory Code

Laboratory Code	Sample R212						
	Result	±	MU[1]	Robust z-score[2]		Method Code[3]	Digestion Code[3]
	µg/L						
103	640	±	25	0.16		7	#
160	614		#	-0.86		13	24
213	767	±	105	5.12	**§**	6	15
230	606	±	17.2	-1.17		6	14
233	636	±	55	0.00		6	#
283	617		#	-0.74		7	15
294	650	±	40	0.55		12	23
317	600	±	120	-1.41		6	#
345	662	±	24.4	1.02		7	14
359	543	±	92	-3.64	**§**	9	24
381	620	±	97	-0.63		12	22
407A	563	±	28	-2.85		7	14
432B	649	±	10	0.51		6	#
445	620	±	65	-0.63		7	14
464	622	±	42	-0.55		13	14
469	650	±	65	0.55		9	#
473	628	±	71	-0.31		9	24
561	645	±	7	0.35		11	#
575	593	±	72	-1.68		7	14
579	756	±	18	4.69	**§**	6	14
603	706		#	2.74		6	#
607	716	±	75	3.13	**§**	6	#
685	650		#	0.55		6	20

No of Results:	23
Median:	636.0
Normalised IQR:	25.6
Uncertainty of the Median:	6.7
Robust CV:	4.0%
Minimum:	543
Maximum:	767
Range:	224

[1] Where reported, results are shown with their corresponding measurement uncertainty (MU).

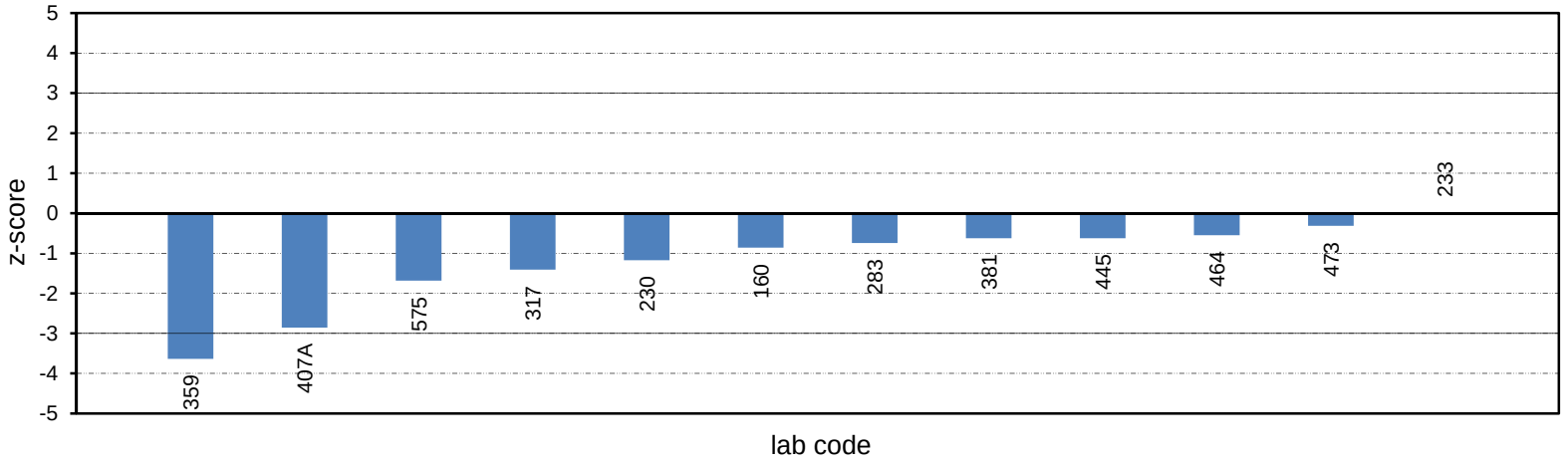
[2] "**§**" denotes an outlier (i.e. those results for which |*z-score*| ≥ 3.0). Robust *z-scores* are calculated *as:* $z = (A - median) \div normalised\ IQR$, where *A* is the participant laboratory's result.

[3] Please refer to Appendix C (pages C3-C4) for method and digestion code descriptions.

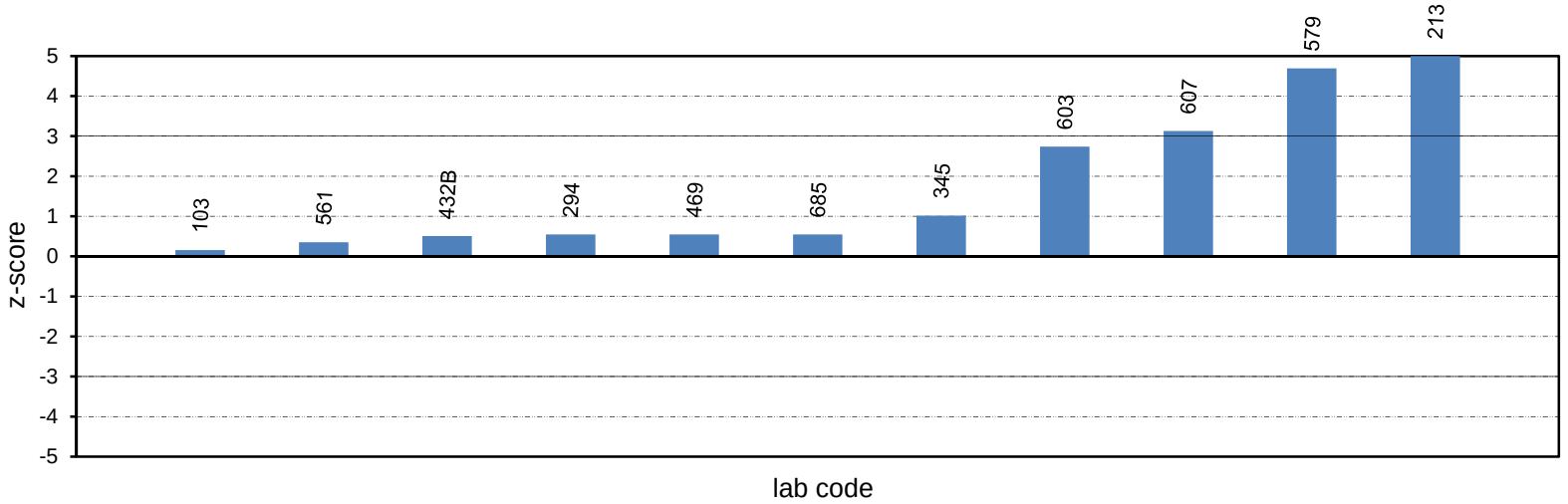
Thallium - Sample R212

Ordered Robust Z-Score Charts

Thallium - Sample R212 - Robust Z-Scores



Robust Z-Scores



Zinc (Zn)
Results

Sample R212

Zinc (Zn)

Results by Laboratory Code

Laboratory Code	Sample R212						
	Result	±	MU[1]	Robust z-score[2]		Method Code[3]	Digestion Code[3]
	µg/L						
103	767	±	31	-0.67		6	#
105	770		#	-0.60		1	14
160	554		#	-5.75	**§**	13	24
213	798	±	36	0.07		6	15
230	834	±	17.2	0.93		6	14
233	752	±	54	-1.03		6	#
251	810		#	0.36		#	#
283	680		#	-2.75		6	15
294	800	±	40	0.12		12	23
303	808	±	40	0.31		6	#
312B	799		#	0.10		11	24
317	786	±	132	-0.21		6	#
330	833		#	0.91		1	14
332	806		#	0.26		6	23
345	837	±	44.3	1.00		7	14
350	800	±	127	0.12		1	14
356	785	±	20	-0.24		1	14
359	669	±	67	-3.01	**§**	9	24
381	737	±	129	-1.38		12	22
407A	525	±	18	-6.45	**§**	6	14
419	753	±	75	-1.00		1	14
432B	852	±	13	1.36		6	#
445	845	±	80	1.19		7	14
451	714	±	20	-1.93		1	#
464	795	±	52	0.00		13	14
469	818	±	82	0.55		9	#
473	775	±	86	-0.48		9	24
486	762		#	-0.79		6	15
490	810	±	100	0.36		6	14

[1] Where reported, results are shown with their corresponding measurement uncertainty (MU).

[2] "**§**" denotes an outlier (i.e. those results for which |*z-score*| ≥ 3.0). Robust *z-scores* are calculated *as:* $z = (A - median) \div normalised\ IQR$, where *A* is the participant laboratory's result.

[3] Please refer to Appendix C (pages C3-C4) for method and digestion code descriptions.

Zinc (Zn) - cont.

Results by Laboratory Code

Laboratory Code	Sample R212						
	Result	±	MU[1]	Robust z-score[2]		Method Code[3]	Digestion Code[3]
	µg/L						
526	826	±	206	0.74		6	#
553	770	±	53	-0.60		1	14
561	800	±	8	0.12		11	#
575	734	±	36	-1.46		6	14
579	951	±	5	3.72	**§**	6	14
586	839	±	32	1.05		6	14
590	800		#	0.12		6	15
603	886		#	2.17		6	#
607	856	±	90	1.46		6	#
622	777	±	19	-0.43		6	15
626	741		#	-1.29		6	#
645	718	±	66	-1.84		6	14
646	789	±	55	-0.14		6	#
685	790	±	73	-0.12		6	20

No of Results:	43
Median:	795.0
Normalised IQR:	41.9
Uncertainty of the Median:	8.0
Robust CV:	5.3%
Minimum:	525
Maximum:	951
Range:	426

[1] Where reported, results are shown with their corresponding measurement uncertainty (MU).

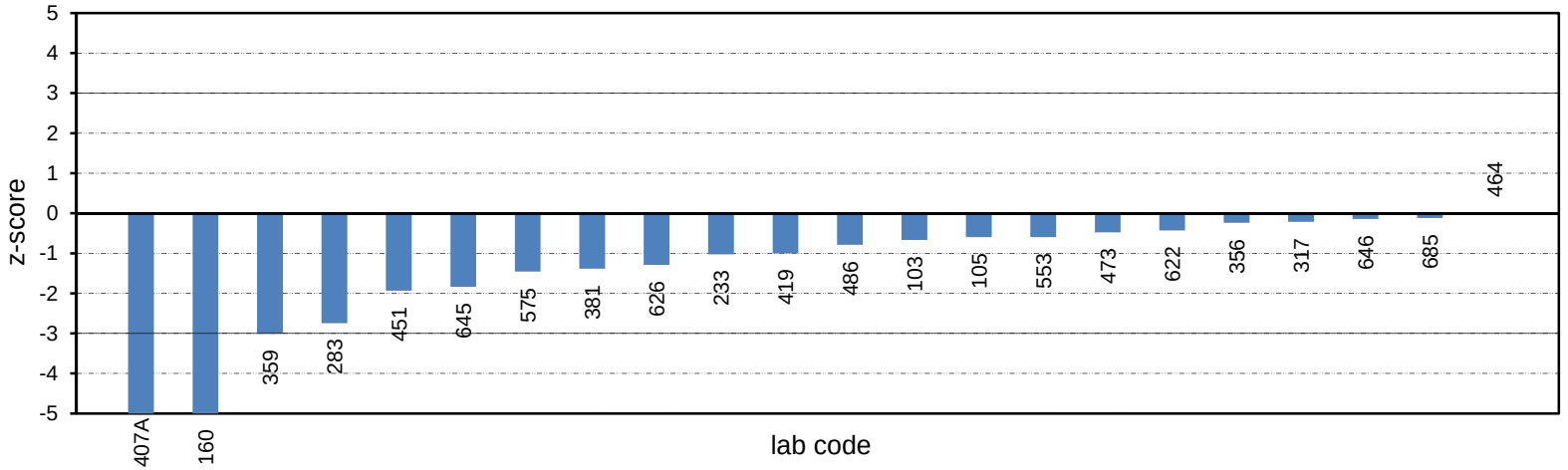
[2] "**§**" denotes an outlier (i.e. those results for which |*z-score*| ≥ 3.0). Robust *z-scores* are calculated *as:* $z = (A - median) \div normalised\ IQR$, where *A* is the participant laboratory's result.

[3] Please refer to Appendix C (pages C3-C4) for method and digestion code descriptions.

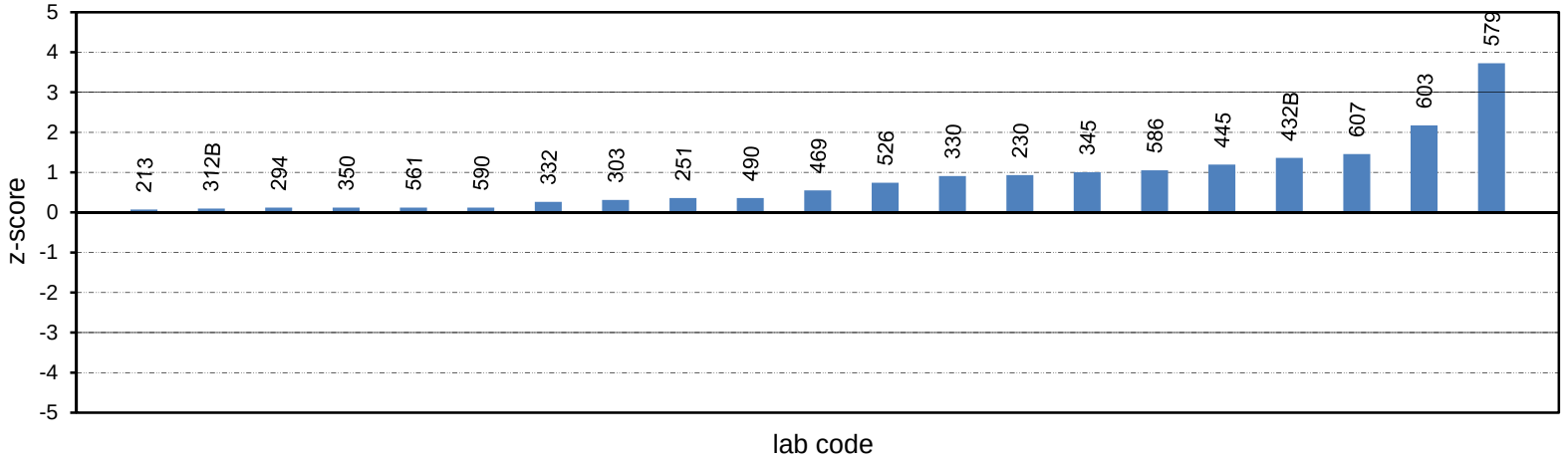
Zinc - Sample R212

Ordered Robust Z-Score Charts

Zinc - Sample R212 - Robust Z-Scores



Robust Z-Scores



APPENDIX B

Sample Homogeneity and Stability

Homogeneity and Stability Testing

Certified reference samples for this program were obtained from Environmental Resource Associates (ERA, USA). As such, all samples are subjected to rigorous stability and homogeneity testing. On the basis of this testing, the samples utilised for this program were considered to be homogeneous and stable.

Table B1 below presents the certification data and analytical verification results prior to sample release[2].

Table B1. Certified values and analytical verification results for samples used in Round 212.

			Analytical Verification		
Analyte	**Certified Value[3]**	**Uncertainty[4] (%)**	**Mean**	**Recovery (%)**	**No. of samples**
Chromium	439	1.04	440	100	72
Copper	734	0.460	740	101	78
Iron	581	0.462	581	99.9	60
Lead	650	2.01	652	100	72
Nickel	1440	0.458	1450	101	66
Thallium	621	2.44	618	99.6	56
Zinc	779	0.462	779	100	71

[2] ERA certification and analytical verification data issued 16 June 2016.

[3] The Certified Values are the actual “made-to” concentrations confirmed by ERA analytical verification.

[4] The stated Uncertainty is the total propagated uncertainty at the 95% confidence interval. The uncertainty is based on the preparation and analytical verification of the product by ERA, multiplied by a coverage factor. The uncertainty applies to the product as supplied and does not take into account any required or optional dilution and/or preparations the laboratory may perform while using this product.

APPENDIX C

Documentation

PROFICIENCY TESTING AUSTRALIA
WATERS PROFICIENCY TESTING PROGRAM

CHEMICAL ANALYSIS ROUND 212 **May, 2017**
Metals (Chromium, Copper, Iron, Lead, Nickel, Thallium, Zinc)

INSTRUCTIONS TO PARTICIPANTS

Please record (on the Results Sheet) the approximate temperature of the samples upon receipt*

Please note the following before commencing the analysis of the samples.

1. Sample Information

i) One sealed vial labelled R212 supplied by Environmental Resource Associates (ERA). The vial contains approximately 14mL of artificial water concentrate.
ii) Please note the temperature of vial on receipt.
iii) The sample has been acidified with approximately 2% (v/v) nitric acid and 1% (w/v) tartaric acid.
iv) The sample must be thoroughly mixed prior to analysis.
v) The vial will require dilution in deionised water (please follow the **Sample Preparation** steps below).
vi) The vial may be stored at room temperature.

Please Note: Where possible, the proficiency testing sample should be treated as a routine laboratory sample.

2. Sample Preparation

i) Analysis must begin immediately after vial is opened.
ii) Prepare sample at 20-22ºC, and allow sufficient time for the vial to reach room temperature before opening.

Please read the Caution notes below before this step

iii) Add approximately 100-200mL deionised water followed by 2-5mL of high purity, concentrated nitric acid to a 500mL volumetric flask.
iv) Mix the vial prior to opening.
v) Using a dry, clean volumetric pipette, transfer 5.0mL from the vial into the flask.
vi) Dilute the flask to the final volume with deionised water.
vii) Stopper and mix by inversion.
viii) Immediately analyse the diluted sample by your normal procedures.
ix) Report your results as µg/L for the diluted sample.

Caution:

- **Caution must be taken when analysing corrosive samples.**
- While technically it is unnecessary to digest the sample prior to analysis, digestion should be performed if this is your normal procedure.
- A volume of acid different from the 2-5mL of nitric acid suggested in **step (iii)** may be added in order to matrix match calibration standards or meet any other method criteria.
- If analysing using colorimetric techniques, it may be necessary to pH adjust the sample prior to analysis. If using colorimetric techniques, it is acceptable to omit the addition of the 2-5mL nitric acid suggested in **step (iii)**.

3. Tests Requested

i) Chromium (Cr)
ii) Copper (Cu)
iii) Iron (Fe)
iv) Lead (Pb)
v) Nickel (Ni)
vi) Thallium (Tl)
vii) Zinc (Zn)

(It is recommended that a reagent water blank is analysed by the same method used to analyse the samples.)

If unable to perform the above please note this on your Results Sheet.

4. Safety

i) Samples are for laboratory use only.
ii) Participants should have sufficient experience and training to take the necessary precautions when handling the samples and reagent chemicals and during disposal.
iii) Use of safety glasses, gloves, and fume hoods, where appropriate during the determinations, is recommended.

5. Reporting

i) Report results to the nearest whole number (no decimal places).
ii) Report results in micrograms per litre (µg/L).
iii) Do not correct results for recovery.
iv) Select the appropriate method code for each test from the Method Code Table and record it on the Results Sheet.
v) Calculate the measurement uncertainty (MU) for each reported result. All estimates of MU must be given as a 95% confidence interval (coverage factor k ≈ 2) and reported in micrograms per litre (µg/L). Report to the nearest whole number (no decimal places).

6. Testing should commence as soon as possible after receiving the samples and results reported **NO LATER THAN 2 JUNE 2017** to:

Delfina Mihaila
Proficiency Testing Australia
PO Box 7507
SILVERWATER NSW 2128
AUSTRALIA
Phone: +612 9736 8397
Fax: +612 9743 6664
Email: dmihaila@pta.asn.au

7. For this program your laboratory has been allocated the code number shown on the attached Results Sheet. All reference to your laboratory in reports associated with the program will be through this code number, thus ensuring the confidentiality of your results.

8. The expected concentration ranges of each of tests are given in the following table.

Analyte	Range (µg/L)
Chromium (Cr)	100 – 1000
Copper (Cu)	100 – 1000
Iron (Fe)	200 – 4000
Lead (Pb)	100 – 1500
Nickel (Ni)	200 – 2000
Thallium (Tl)	80 – 800
Zinc (Zn)	300 – 2000

Method Codes to be used for the Results Sheet

ANALYSIS	METHOD REFERENCE	METHOD DESCRIPTION	CODE
Chromium (Cr) Copper (Cu) Iron (Fe) Lead (Pb) Nickel (Ni) Thallium (Tl) Zinc (Zn)	APHA SM	APHA 3111 B. Direct Air-Acetylene Flame Method	1
		APHA 3111 C. Extraction/Air-Acetylene Flame Method	2
		APHA 3111 D. Direct Nitrous Oxide-Acetylene Flame Method	3
		APHA 3111 E. Extraction/Nitrous Oxide-Acetylene Flame Method	4
		APHA 3113 B. Electrothermal Atomic Absorption Spectrometric Method	5
		APHA 3120 B. METALS BY PLASMA EMISSION SPECTROSCOPY Inductively Coupled Plasma (ICP) Method	6
		APHA 3125 B. Inductively-Coupled Plasma/Mass Spectrometry (ICP/MS) Method	7
	US EPA	US EPA 0200.7 Metals and Trace Elements - ICP/AES	8
		US EPA 0200.8 Trace Elements in Water & Wastes - ICP/MS	9
		US EPA 0200.9 Trace Elements - GFAA	10
		US EPA 6010 Inductively Coupled Plasma-Atomic Emission Spectrometry	11
		US EPA 6020 A Inductively Coupled Plasma/MS	12
	Other	Other (please specify)	13

Digestion Codes to be used for the Results Sheet

DIGESTION PROCEDURE	CODE
APHA	
APHA 3030 E (HNO_3)	14
APHA 3030 F (HNO_3/HCl)	15
APHA 3030 G (HNO_3/H_2SO_4)	16
APHA 3030 H (HNO_3/$HClO_4$)	17
APHA 3030 I (HNO_3/$HClO_4$/HF)	18
APHA 3030 J (Dry Ashing)	19
APHA 3030 K (Microwave Assisted)	20
US EPA	
US EPA 3005 A (HNO_3/HCl)	21
US EPA 3010 A (HNO_3/HCl)	22
US EPA 3015 A (Microwave Assisted)	23
Other (please specify)	24

Method Reference Key

i) APHA SM — APHA "*Standard Methods for the Examination of Water and Wastewater*" (18, 19, 20, 21 and 22 Edition).

ii) USEPA — U.S Environmental Protection Agency, http://www.epa.gov/osa/fem/methcollectns.htm.

PROFICIENCY TESTING AUSTRALIA

WATERS PROFICIENCY TESTING PROGRAM

CHEMICAL ANALYSIS ROUND 212

Metals (Chromium, Copper, Iron, Lead, Nickel, Thallium, Zinc)

MAY 2017

RESULTS SHEET
(µg/L)

Laboratory Code	

*Approximate temperature of samples upon receipt:	

ANALYSIS	SAMPLE R212		METHOD CODE	DIGESTION CODE
	Result	±MU		
Chromium (Cr)				
Copper (Cu)				
Iron (Fe)				
Lead (Pb)				
Nickel (Ni)				
Thallium (Tl)				
Zinc (Zn)				

Please note: Where possible, the proficiency testing sample should be treated as a routine laboratory sample.

i) For each analyte only a single result is requested.

ii) Report results for the diluted sample.

iii) Report results to the nearest whole number (no decimal places).

iv) Report results in micrograms per litre (**µg/L**).

v) Do not correct results for recovery.

vi) MU* Laboratories Measurement Uncertainty (MU) if known for the result. Please report in micrograms per litre (**µg/L**). Report to the nearest whole number (no decimal places).

DATE: _____ **SIGNATURE:** _____

Return results **NO LATER THAN 2 JUNE 2017** to:
Delfina Mihaila
Proficiency Testing Australia
PO Box 7507
SILVERWATER NSW 2128
AUSTRALIA

Phone: +61 2 9736 8397
Fax: +61 2 9743 6664
Email: dmihaila@pta.asn.au

- End of Report -