



Report No. 545

Waters Proficiency Testing

Sub-Program 92

-Priority Pollutant Phenols -

June 2007

Acknowledgments

PTA gratefully wishes to acknowledge the technical assistance provided for this program by Dr I Eckhard, Advanced Analytical Australia Pty Ltd. Also our thanks go to the EPA of Victoria who continue to provide laboratory space for these ongoing programs.

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1. Foreword

This report summarises the results of a proficiency testing program on the determination of Priority Pollutant Phenols in waters. This is sub-program 92 in a planned series of programs involving the analysis of chemical and physical parameters of waters.

The exercise was conducted in March 2007 by Proficiency Testing Australia (PTA). The main aim of the program was to assess laboratories' abilities to competently perform the prescribed analyses.

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.

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

2.3 Participants were provided with one sealed glass ampoule (labelled A7001) supplied by the New York State Department of Health, Wadsworth Centre for laboratories and research. The ampoule contained priority pollutant phenols concentrates.

2.4 A total of 33 laboratories received samples, comprising:

- 29 Australian participants; and
- 4 overseas participants, including:
 - Malaysia (1), New Zealand (2) and Vietnam (1).

Of these 33 laboratories, only 1 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, minimum, maximum and range) are presented in Appendix A (for each sample and 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 z-score charts relevant to each test are presented in Appendix A.

The document entitled *Guide to Proficiency Testing Australia, 2006* (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 extreme or outlier results can be found on page 8.

2.8 Ampoules for the program were supplied by the New York State Department of Health, Wadsworth Center for Laboratories and Research. These ampoules were subjected to rigorous stability and homogeneity testing by the New York State Department of Health. Based on this testing, the ampoules utilised for this program were considered to be homogeneous. As such, any results identified as extreme could not be attributed to any significant 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 close to zero indicates that the result agrees well with those from other laboratories. Whereas, a z-score with an absolute value greater than three is considered to be an outlier and is marked by the symbol "§".

Each determination was examined for outliers with all methods pooled. The table on page 8 summarises the outlier results detected.

3.2 Results Tables and Summary Statistics

Each of these tables contains 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 significant figures) requested on the Results Sheet have **not** been rounded to the requested precision before being included in the statistical analysis.

Results reported as "ND" have been considered "not determined" (rather than not detected) and have been shown as "#" in the appended tables.

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

- the number of results for that test/sample (*No. of Results*);
- the median of these results, i.e. the middle value (*Median*);
- the normalised interquartile range of the results (*Normalised IQR*);
- the robust coefficient of variation, expressed as a percentage (*Robust CV*) - i.e. $100 \times \text{Normalised IQR} / \text{Median}$;
- the minimum and maximum laboratory results; and
- the range (*Maximum - 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 0.7413, a 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).

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

3.3 Ordered Z-Score Charts

On these charts each laboratory's robust z-score is shown, in order of magnitude, and is marked with its code number. From these charts, each laboratory can readily compare its performance relative to the other laboratories.

These charts contain solid lines at +3 and -3, 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 Robust CV's are similar to those from three previous NATA programs, PTAC 423 (July 2003), PTAC 313 (February 2000) and PTAC 208 (November 1996):

(note NR = Not requested)

Robust CV Comparison Table

Analyte	Program	Ampoule	Median ($\mu\text{g/L}$)	Robust CV (%)
4-chloro-3-methylphenol	This round	A7001	95.5	22.0
	PTAC 423	PTS035	134.0	15.5
		PTS535	122.0	12.8
	PTAC 313	0315	96.8	29.6
1315		78.7	26.1	
PTAC 208	NR	NR	NR	
2-chlorophenol	This round	A7001	150.0	18.3
	PTAC 423	PTS035	125.0	27.6
		PTS535	57.8	16.1
	PTAC 313	0315	97.6	28.9
1315		94.8	21.7	
PTAC 208	1527	42.4	17.5	
	1528	111.0	24.1	
2,4-dichlorophenol	This round	A7001	59.9	15.5
	PTAC 423	PTS035	162.0	16.0
		PTS535	33.3	14.7
	PTAC 313	0315	91.6	24.8
1315		72.5	24.8	
PTAC 208	NR	NR	NR	

Analyte	Program	Ampoule	Median ($\mu\text{g/L}$)	Robust CV (%)
2,4-dimethylphenol	This round	A7001	75.3	14.0
	PTAC 423	PTS035 PTS535	110.0 120.0	15.9 15.4
	PTAC 313	0315 1315	78.5 98.1	18.4 26.5
	PTAC 208	NR	NR	NR
2,4-dinitrophenol	This round	A7001	132.5	15.0
	PTAC 423	PTS035 PTS535	100.7 90.0	24.7 27.0
	PTAC 313	0315 1315	87.3 108.0	22.0 29.3
	PTAC 208	1527 1528	82.7 132.5	50.3 33.4
2-methyl-4,6-dinitrophenol	This round	A7001	94.0	35.3
	PTAC 423	PTS035 PTS535	121.0 72.8	40.6 33.8
	PTAC 313	0315 1315	112.4 89.6	27.5 44.8
	PTAC 208	NR	NR	NR
2-methyl phenol (o-cresol)	Not requested in previous programs			
4methyl phenol (p -cresol)	Not requested in previous programs			
2-nitrophenol	This round	A7001	70.8	13.7
	PTAC 423	PTS035 PTS535	116.5 115.5	23.9 20.9
	PTAC 313	0315 1315	94.3 88.2	22.6 30.8
	PTAC 208	NR	NR	NR

Analyte	Program	Ampoule	Median ($\mu\text{g/L}$)	Robust CV (%)
4-nitrophenol	This round	A7001	64.9	39.7
	PTAC 423	PTS035	39.0	36.4
		PTS535	58.4	42.6
	PTAC 313	0315	68.1	48.8
1315		60.1	63.6	
PTAC 208	NR	NR	NR	NR
Pentachloro phenol	This round	A7001	69.7	13.2
	PTAC 423	PTS035	75.6	24.2
		PTS535	92.3	32.9
	PTAC 313	0315	77.2	23.1
1315		92.3	33.8	
PTAC 208	1527	64.8	18.6	24.9
		1528	100.4	
phenol	This round	A7001	81.1	59.5
	PTAC 423	PTS035	110.0	63.8
		PTS535	76.6	68.3
	PTAC 313	0315	78.0	84.2
1315		61.6	65.9	
PTAC 208	1527	39.7	52.9	49.3
		1528	60.2	
2,4,5 trichlorophenol	This round	A7001	115.0	11.3
	PTAC 423	PTS035	157.5	20.6
		PTS535	69.0	14.5
	PTAC 313	0315	89.4	23.0
1315		77.4	30.0	
PTAC 208	NR	NR	NR	NR
2,4,6 trichlorophenol	This round	A7001	68.7	19.9
	PTAC 423	PTS035	121.0	19.5
		PTS535	84.2	14.0
	PTAC 313	0315	103.0	25.1
1315		70.1	21.5	
PTAC 208	NR	NR	NR	NR

- 4.2 Outliers are results with an absolute z-score greater than 3 and they are identified in the table on page 6. These laboratories should examine their procedures to determine, if possible, the reason(s) for error. For 2,4-dinitrophenol, 2-methyl-4,6-dinitrophenol and 4-nitrophenol the results for laboratories code 633 and 822 have not been included in the statistical analysis and thus z-scores have not been calculated. These laboratories are also advised to examine their procedures.
- 4.3 From investigations into outlier results in previous programs the following have been reported:
- Dilution errors
 - Transcription errors
 - Deterioration of reference standards
 - Incorrect integration of peak area.
- 4.4 As noted in the Robust CV Comparison Table above the overall performance is similar to those from the three previous NATA programs, however, the following matters were noted:
- All labs (except one) are now using GCMS (methods 7, 8 or 11);
 - Phenols are difficult analytes to accurately quantitate by gas chromatography, but it is disappointing that there has been no significant reduction in the spread of data shown by participating labs, with 5 labs showing 3 or more z-score outliers;
 - Chromatography issues leading to incorrect peak area integration are probably responsible for the wide spread of results. This is reflected in the large uncertainty reported for most of the results;
 - 2,4-dinitrophenol, 2-methyl-4,6-dinitrophenol and 4-nitrophenol continue to be problem compounds with half or more of the laboratories choosing not to report any results for these analytes.

5. Outlier or Extreme Results

Laboratories reporting outlier **or extreme** results are listed in the following table:

Lab Code	Analysis									
	4-chloro-3-methylphenol	2-chlorophenol	2,4-dichlorophenol	2,4-dimethylphenol	2,4-dinitrophenol	4-methylphenol (p-cresol)	2-nitrophenol	Pentachlorophenol	2,4,5-trichlorophenol	2,4,6-trichlorophenol
322		§	§						§	
372					§					
504			§	§			§		§	
511					§		§	§		
544		§	§			§	§		§	
559	§									
808						§		§	§	§
821								§		

¹ A “§” indicates the occurrence of a z-score outlier result (i.e. those results for which $|z\text{-score}| > 3$).

6. References

[1] *Guide to Proficiency Testing Australia*, 2006, Version 1

APPENDIX A

Results & Data Analysis

4-chloro-3-methylphenol	A1
2-chlorophenol.....	A3
2,4-dichlorophenol.....	A5
2,4-dimethylphenol.....	A7
2,4-dinitrophenol.....	A9
2-methyl-4,6-dinitrophenol.....	A11
2-methylphenol (o-cresol).....	A13
4-methylphenol (p-cresol).....	A15
2-nitrophenol	A17
4-nitrophenol	A19
pentachlorophenol.....	A21
phenol	A23
2,4,5-trichlorophenol	A25
2,4,6-trichlorophenol	A27

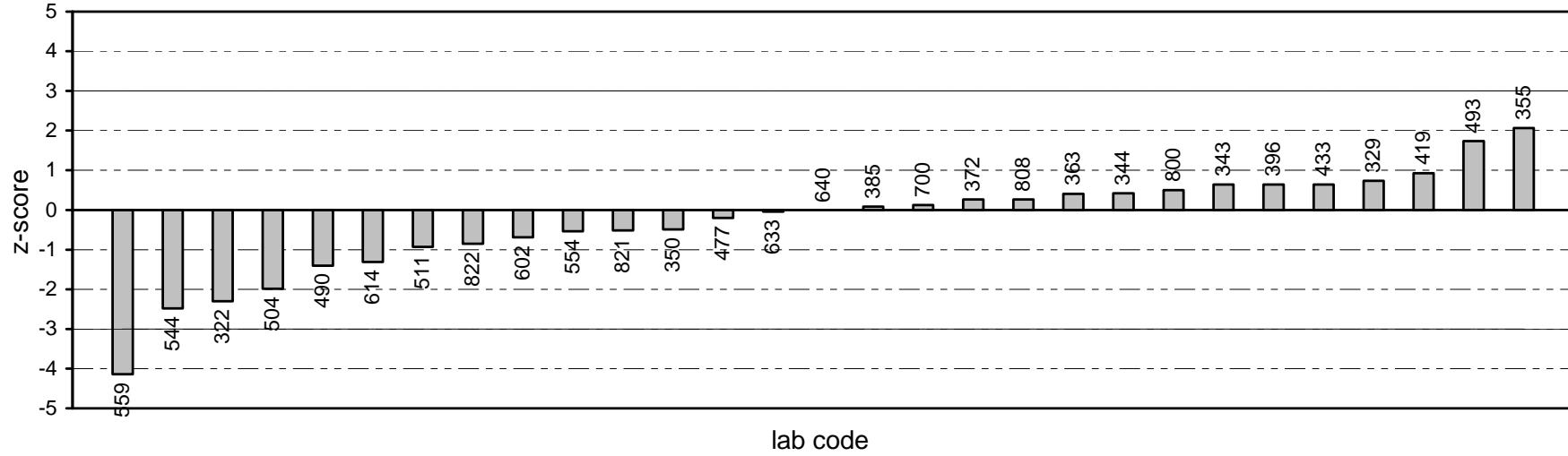
4-chloro-3-methylphenol
Results by Laboratory Code

Lab Code	Ampoule A7001			Method Code ³
	Result ± MU ¹ (µg/L)		Robust z-score ²	
322	47	#	-2.30	8
329	111 ±	22.20	0.74	11
343	109 ±	34.00	0.64	8
344	104.3 ±	32.50	0.42	8
350	85.1 ±	15.70	-0.49	8
355	139 ±	28.00	2.07	8
363	104 ±	21.00	0.40	11
372	101 ±	31.00	0.26	11
385	97.2 ±	14.60	0.08	8
396	109 ±	13.00	0.64	8
419	115	#	0.93	11
433	109 ±	13.10	0.64	11
477	91.2	#	-0.20	7
490	66 ±	0.20	-1.40	11
493	132 ±	21.00	1.73	7
504	53.7 ±	5.40	-1.99	8
511	75.9 ±	8.00	-0.93	8
544	43.3	#	-2.48	11
554	84.1 ±	4.22	-0.54	8
559	8.3	#	-4.14	§
602	81 ±	25.00	-0.69	8
614	68 ±	7.50	-1.31	7
633	94.6 ±	19.00	-0.04	8
640	95.5 ±	16.80	0.00	1
700	98 ±	25.00	0.12	8
800	106 ±	15.80	0.50	8
808	101 ±	10.00	0.26	8
821	84.6 ±	26.00	-0.52	8
822	77.6 ±	16.10	-0.85	8

<i>No of Results:</i>	29
<i>Median:</i>	95.50
<i>Normalised IQR:</i>	21.05
<i>Robust CV:</i>	22.0%
<i>Minimum:</i>	8
<i>Maximum:</i>	139
<i>Range:</i>	130.7

¹ Where reported, results are shown with their corresponding measurement uncertainty (MU).
² "§"s denote outliers (i.e. those results for which |z-score| > 3). Robust z-scores are calculated as:
 $z = (A - \text{median}) \div \text{normalised IQR}$, where, A is the participant laboratory's result.
³ Please refer to Appendix C (page C3) for method code descriptions.
⁴ A "#" indicates that no result/response was returned

4-chloro-3-methylphenol - Ampoule A7001 - Robust Z-Scores



Robust Z-Scores

Ordered Robust Z-Score Charts

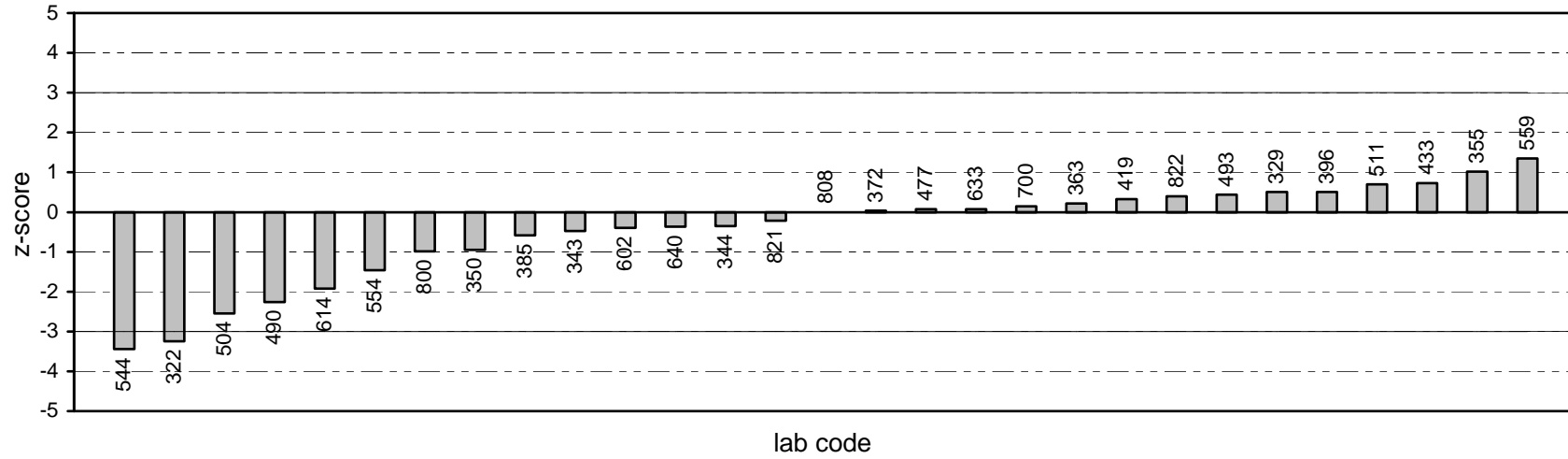
2-chlorophenol
Results by Laboratory Code

Lab Code	Ampoule A7001			Method Code ³
	Result ± MU ¹ (µg/L)		Robust z-score ²	
322	61	#	-3.24 §	8
329	164 ±	32.8	0.51	11
343	137 ±	45	-0.47	8
344	140.5 ±	46.4	-0.35	8
350	124 ±	17.9	-0.95	8
355	178 ±	36	1.02	8
363	156 ±	19	0.22	11
372	151 ±	45	0.04	11
385	134 ±	20.1	-0.58	8
396	164 ±	22	0.51	8
419	159	#	0.33	11
433	170 ±	20.4	0.73	11
477	152	#	0.07	7
490	87.9 ±	0.2	-2.26	11
493	162 ±	38	0.44	7
504	80.1 ±	8	-2.55	8
511	169 ±	17	0.69	8
544	55.5	#	-3.45 §	11
554	110 ±	5.5	-1.46	8
559	187	#	1.35	8
602	139 ±	46	-0.40	8
614	97 ±	14.5	-1.93	7
633	152 ±	37	0.07	8
640	140 ±	10.1	-0.36	1
700	154 ±	25	0.15	8
800	123 ±	16	-0.98	8
808	150 ±	15	0.00	8
821	144 ±	48	-0.22	8
822	161 ±	39.8	0.40	8

No of Results: 29
Median: 150.00
Normalised IQR: 27.43
Robust CV: 18.3%
Minimum: 56
Maximum: 187
Range: 131.5

¹ Where reported, results are shown with their corresponding measurement uncertainty (MU).
² "§"s denote outliers (i.e. those results for which |z-score| > 3). Robust z-scores are calculated as: $z = (A - \text{median}) \div \text{normalised IQR}$, where, A is the participant laboratory's result.
³ Please refer to Appendix C (page C3) for method code descriptions.
⁴ A "#" indicates that no result/response was returned

2-chlorophenol - Ampoule A7001 - Robust Z-Scores



Ordered Robust Z-Score Charts

Robust Z-Scores

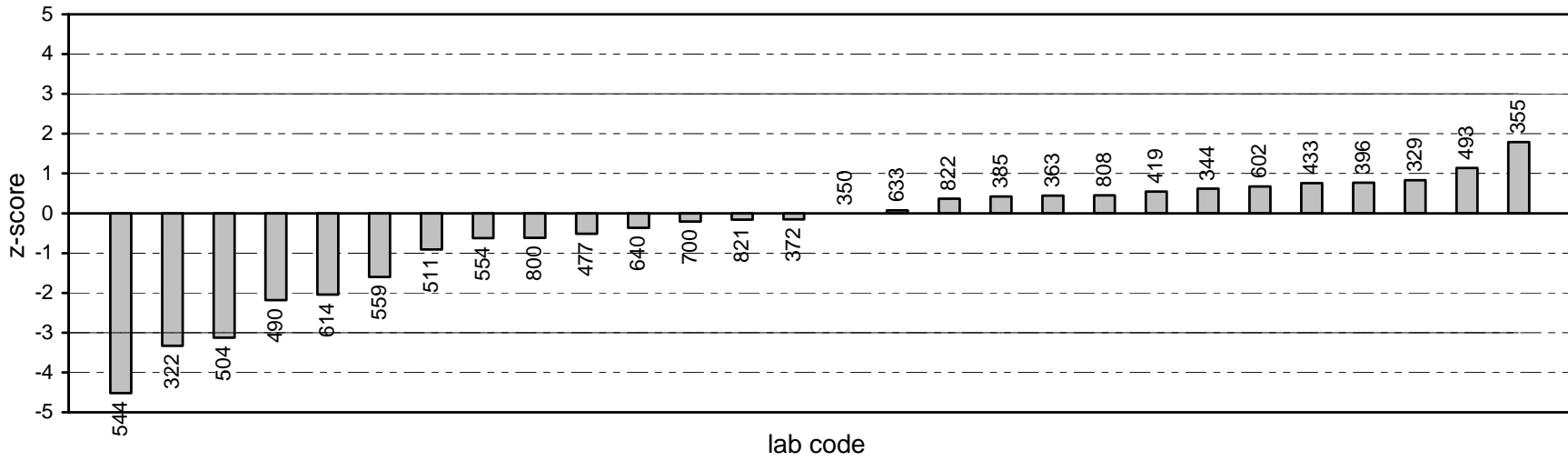
2,4-dichlorophenol
Results by Laboratory Code

Lab Code	Ampoule A7001			Method Code ³
	Result ± MU ¹ (µg/L)		Robust z-score ²	
322	29	#	-3.33 §	8
329	67.6 ±	13.50	0.83	11
344	65.6 ±	21.0	0.62	8
350	59.9 ±	3.83	0.00	8
355	76.5 ±	15.00	1.79	8
363	64 ±	26.0	0.44	11
372	58.5 ±	19.00	-0.15	11
385	63.8 ±	9.57	0.42	8
396	67 ±	8.00	0.77	8
419	65	#	0.55	11
433	66.9 ±	10.00	0.76	11
477	55.1	#	-0.52	7
490	39.7 ±	0.20	-2.18	11
493	70.4 ±	7.40	1.13	7
504	30.9 ±	3.10	-3.13 §	8
511	51.5 ±	5.00	-0.91	8
544	18.0	#	-4.52 §	11
554	54.1 ±	2.71	-0.63	8
559	45.1	#	-1.60	8
602	66.1 ±	21.0	0.67	8
614	41 ±	5.50	-2.04	7
633	60.6 ±	13.00	0.08	8
640	56.5 ±	13.20	-0.37	1
700	58 ±	25.00	-0.21	8
800	54.2 ±	15.80	-0.62	8
808	64.1 ±	7.00	0.45	8
821	58.4 ±	19.0	-0.16	8
822	63.3 ±	13.70	0.37	8

No of Results:	27
Median:	59.90
Normalised IQR:	9.27
Robust CV:	15.5%
Minimum:	18
Maximum:	77
Range:	58.5

¹ Where reported, results are shown with their corresponding measurement uncertainty (MU).
² "§"s denote outliers (i.e. those results for which |z-score| > 3). Robust z-scores are calculated as: $z = (A - \text{median}) \div \text{normalised IQR}$, where, A is the participant laboratory's result.
³ Please refer to Appendix C (page C3) for method code descriptions.
⁴ A "#" indicates that no result/response was returned

2,4-dichlorophenol - Ampoule A7001 - Robust Z-Scores



Ordered Robust Z-Score Charts

Robust Z-Scores

2,4-dimethylphenol
Results by Laboratory Code

Ampoule A7001					
Lab Code	Result ± MU ¹ (µg/L)	Robust z-score ²	Method Code ³		
477	70.3	#	-0.56		7
329	90 ± 18.00		1.32		11
504	42.6 ± 4.30		-3.20	§	8
355	101 ± 20.00		2.37		8
343	77.0 ± 36.30		0.08		8
344	84.8 ± 39.90		0.83		8
602	85.7 ± 39.00		0.91		8
821	74.3 ± 35.00		-0.18		8
363	82 ± 16.00		0.56		11
511	72.6 ± 7.00		-0.34		8
493	73.6 ± 11.00		-0.24		7
396	100 ± 12.00		2.28		8
419	79	#	0.27		11
385	90.2 ± 13.50		1.34		8
372	75.3 ± 21.00		-0.08		11
433	84.6 ± 10.20		0.81		11
554	62.3 ± 3.12		-1.32		8
633	78.8 ± 18.00		0.25		8
822	82.1 ± 19.40		0.57		8
700	63 ± 25.00		-1.26		8
808	70.6 ± 7.00		-0.53		8
544	46	#	-2.88		11
559	55.1	#	-2.01		8
640	71.3 ± 3.99		-0.46		1

<i>No of Results:</i>	24
<i>Median:</i>	76.15
<i>Normalised IQR:</i>	10.47
<i>Robust CV:</i>	13.8%
<i>Minimum:</i>	43
<i>Maximum:</i>	101
<i>Range:</i>	58.4

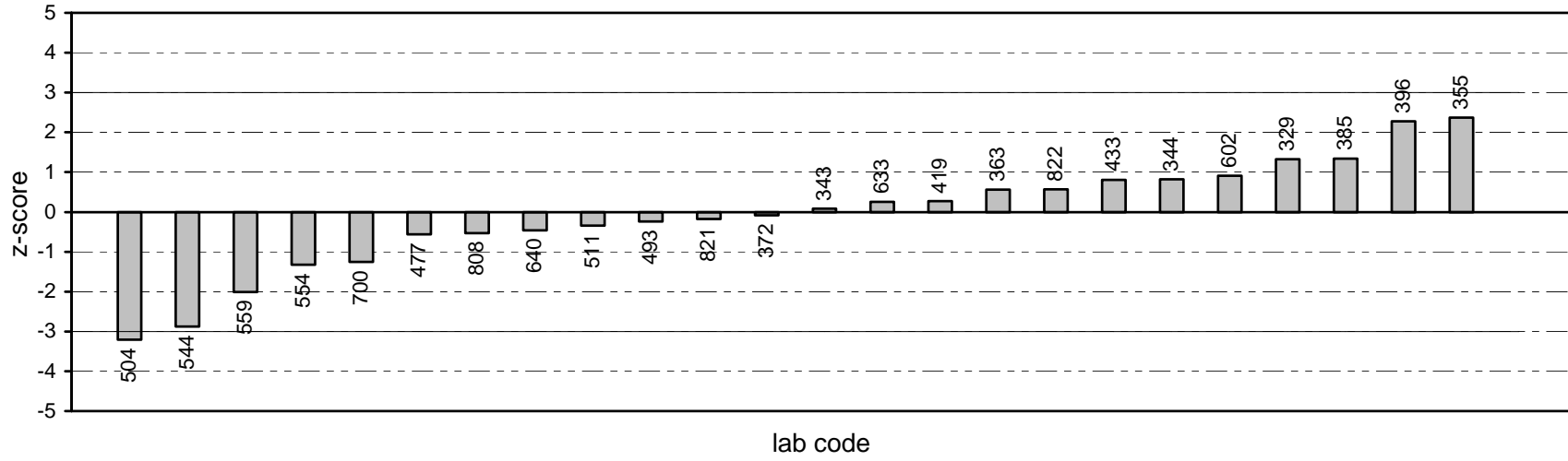
¹ Where reported, results are shown with their corresponding measurement uncertainty (MU).

² "§"s denote outliers (i.e. those results for which |z-score| > 3). Robust z-scores are calculated as: $z = (A - \text{median}) \div \text{normalised IQR}$, where, A is the participant laboratory's result.

³ Please refer to Appendix C (page C3) for method code descriptions.

⁴ A "#" indicates that no result/response was returned

2,4-dimethylphenol - Ampoule A7001 - Robust Z-Scores



Robust Z-Scores

Ordered Robust Z-Score Charts

2,4-dinitrophenol
Results by Laboratory Code

Ampoule A7001					
Lab Code	Result ± MU ¹ (µg/L)		Robust score ²	z-	Method Code ³
350	144	± 9.22	0.58		8
372	72.3	± 22.00	-3.02	§	11
385	132	± 66.00	-0.03		8
396	133	± 21.00	0.03		8
419	141	#	0.43		11
433	172	± 25.80	1.98		11
477	142	#	0.48		7
490	119.8	± 0.20	-0.64		11
504	103	± 10.30	-1.48		8
511	11.1	± 1.00	-6.09	§	8
640	155	#	1.13		1
700	129	± 25.00	-0.18		8
633 ⁵	<2	#			8
822 ⁵	<2	#			#

No of Results: 14
Median: 132.50
Normalised IQR: 19.94
Robust CV: 15.0%
Minimum: 11
Maximum: 172
Range: 160.9

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

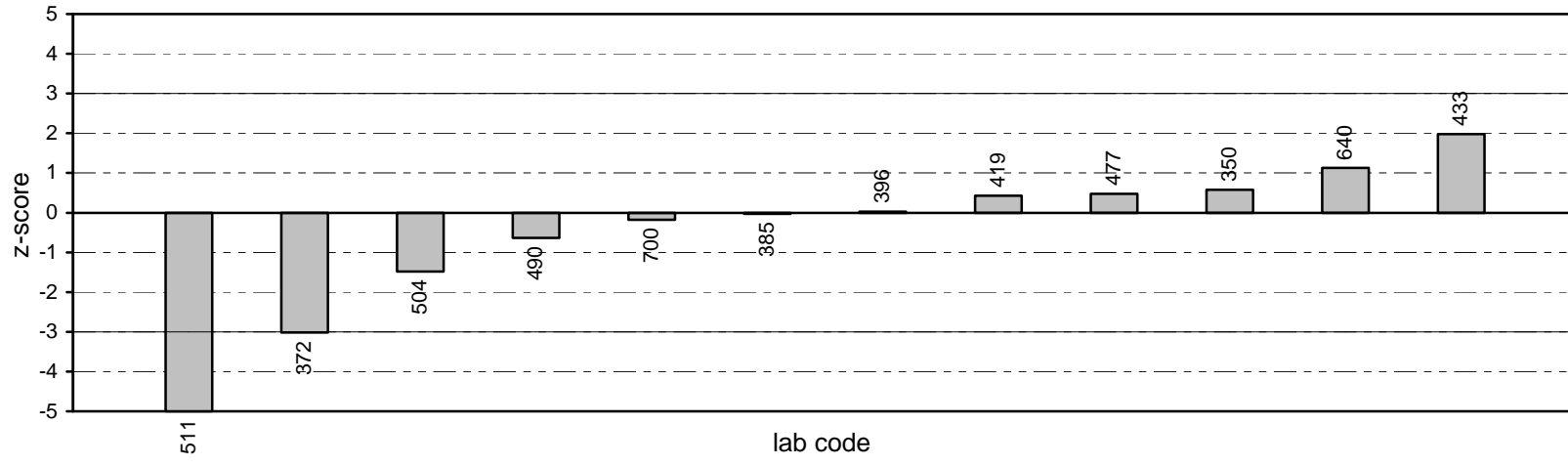
² "§"s denote outliers (i.e. those results for which |z-score| > 3). Robust z-scores are calculated as: z = (A - median) ÷ normalised IQR, where, A is the participant laboratory's result.

³ Please refer to Appendix C (page C3) for method code descriptions.

⁴ A "#" indicates that no result/response was returned

⁵ These results were not included as part of statistical analysis thus robust z-scores not calculated.

2,4-dinitrophenol - Ampoule A7001 - Robust Z-Scores



Ordered Robust Z-Score Chart

Robust Z-Scores

2-methyl-4,6-dinitrophenol

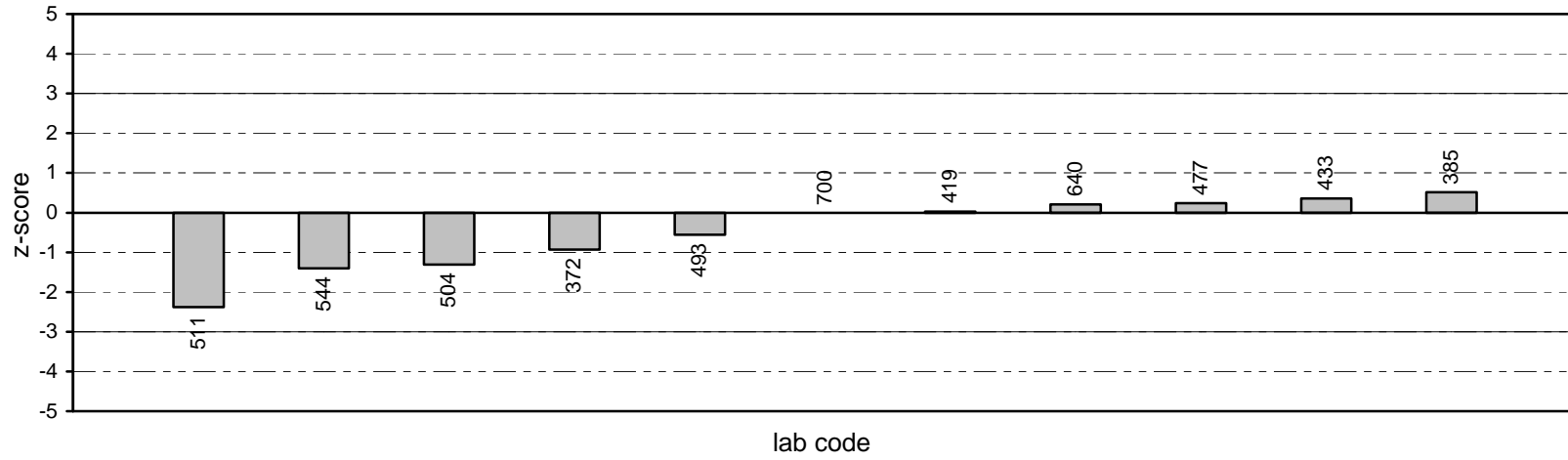
Results by Laboratory Code

Ampoule A7001				
Lab Code	Result ± MU ¹ (µg/L)		Robust z-score ²	Method Code ³
372	63	± 19.00	-0.93	11
385	111	± 56.00	0.51	8
419	95	#	0.03	11
433	106	± 12.70	0.36	11
477	102	#	0.24	7
493	75.5	± 25.00	-0.56	7
504	50.5	± 5.10	-1.31	8
511	15.1	± 2.00	-2.38	8
544	47.3	#	-1.41	11
640	101	± 15.20	0.21	1
700	94	± 25.00	0.00	8
633 ⁵	<2	#		8
822 ⁵	<2	#		#

No of Results:	13
Median:	94.00
Normalised IQR:	33.17
Robust CV:	35.3%
Minimum:	15
Maximum:	111
Range:	95.9

- ¹ Where reported, results are shown with their corresponding measurement uncertainty (MU).
- ² "S"s denote outliers (i.e. those results for which |z-score| > 3). Robust z-scores are calculated as: $z = (A - \text{median}) \div \text{normalised IQR}$, where, A is the participant laboratory's result.
- ³ Please refer to Appendix C (page C3) for method code descriptions.
- ⁴ A "#" indicates that no result/response was returned
- ⁵ These results were not included as part of statistical analysis thus robust z-scores not calculated.

2-methyl-4,6-dinitrophenol - Ampoule A7001 - Robust Z-Scores



Ordered Robust Z-Score Chart

Robust Z-Scores

2-methylphenol (o-cresol)

Results by Laboratory Code

Ampoule A7001				
Lab Code	Result ± MU ¹ (µg/L)	Robust z-score ²	Method Code ³	
329	140 ± 28.00	1.51	11	
343	109 ± 45.00	0.07	8	
344	106.2 ± 43.60	-0.06	8	
350	103 ± 6.59	-0.21	8	
355	149 ± 30.00	1.93	8	
363	142 ± 28.00	1.60	11	
372	133 ± 35.00	1.19	11	
385	106 ± 15.90	-0.07	8	
396	136 ± 19.00	1.33	8	
419	129 #	1.00	11	
477	103 #	-0.21	7	
490	69 ± 0.20	-1.79	11	
493	127 ± 20.00	0.91	7	
504	60.3 ± 6.00	-2.20	8	
511	107 ± 11.00	-0.02	8	
544	64.2 #	-2.01	11	
554	82.2 ± 4.11	-1.18	8	
559	90.5 #	-0.79	8	
602	107 ± 44.00	-0.02	8	
633	134 ± 29.00	1.23	8	
640	123 ± 8.95	0.72	1	
700	126 ± 25.00	0.86	8	
800	94.3 ± 16.30	-0.61	8	
808	108 ± 11.00	0.02	8	
821	106 ± 44.00	-0.07	8	
822	137 ± 29.70	1.37	8	
No of Results:	26			
Median:	107.50			
Normalised IQR:	21.50			
Robust CV:	20.0%			
Minimum:	60			
Maximum:	149			
Range:	88.7			

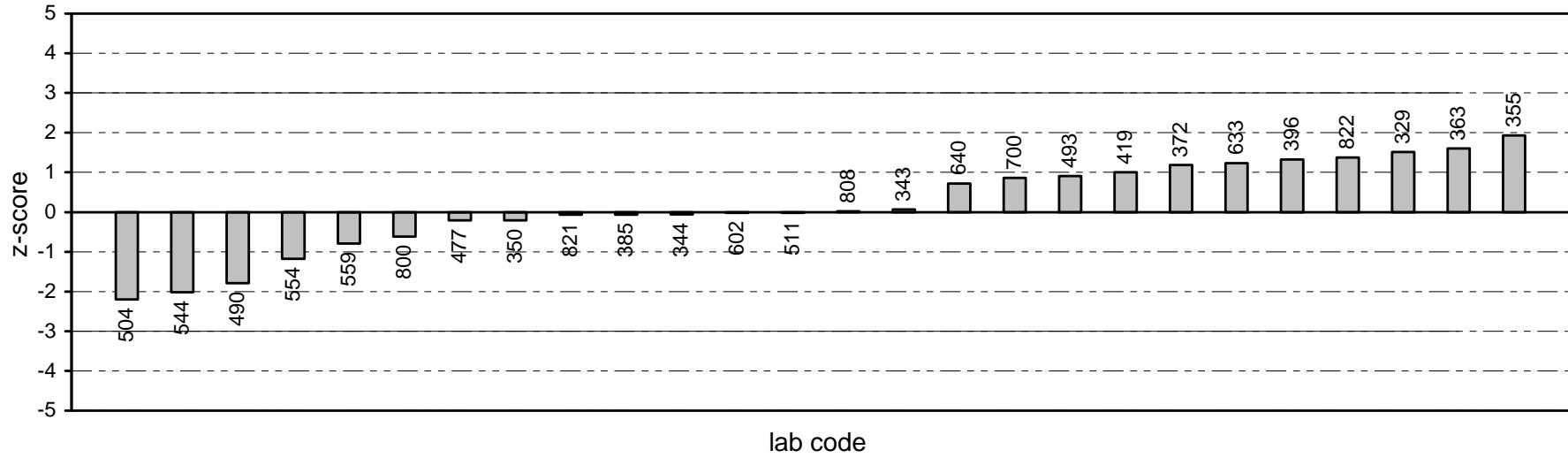
¹ Where reported, results are shown with their corresponding measurement uncertainty (MU).

² "S"s denote outliers (i.e. those results for which |z-score| > 3). Robust z-scores are calculated as: $z = (A - \text{median}) \div \text{normalised IQR}$, where, *A* is the participant laboratory's result.

³ Please refer to Appendix C (page C3) for method and digestion code descriptions.

⁴ A "#" indicates that no result/response was returned

2-methylphenol (o-cresol) - Ampoule A7001 - Robust Z-Scores



Ordered Robust Z-Score Charts

Robust Z-Scores

4-methylphenol (p-cresol)

Results by Laboratory Code

Ampoule A7001				
Lab Code	Result ± MU ¹ (µg/L)		Robust z-score ²	Method Code ³
329	97.9	± 19.60	0.80	11
343	77.3	± 31.40	-0.87	8
350	79.4	± 5.08	-0.70	8
355	117	± 23.00	2.36	8
363	93	± 19.00	0.41	11
372	105	± 28.00	1.38	11
385	78.1	± 11.70	-0.80	8
396	103	± 19.00	1.22	8
419	90	#	0.16	11
477	77.3	#	-0.87	7
490	58	± 0.20	-2.44	11
493	84	± 11.10	-0.33	7
511	108	± 11.00	1.63	8
544	46.6	#	-3.36	§ 11
554	53.9	± 2.69	-2.77	8
559	88	#	0.00	8
633	93.9	± 21.00	0.48	8
640	88.8	± 6.11	0.07	1
700	88	± 25.00	0.00	8
800	70.9	± 26.40	-1.39	8
808	39.7	± 4.00	-3.93	§ 8
822	93.9	± 21.60	0.48	8

No of Results:	21
Median:	88.00
Normalised IQR:	12.31
Robust CV:	14.0%
Minimum:	40
Maximum:	117
Range:	77.3

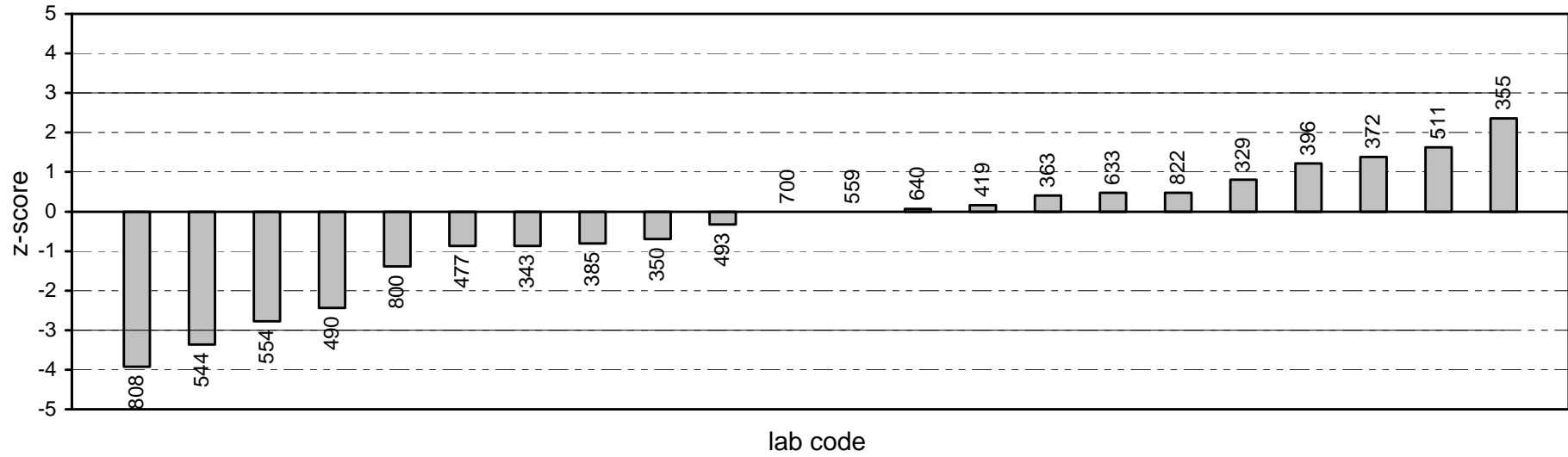
¹ Where reported, results are shown with their corresponding measurement uncertainty (MU).

² "§"s denote outliers (i.e. those results for which |z-score| > 3). Robust z-scores are calculated as: $z = (A - \text{median}) \div \text{normalised IQR}$, where, A is the participant laboratory's result.

³ Please refer to Appendix C (page C3) for method code descriptions.

⁴ A "#" indicates that no result/response was returned

4-methylphenol (p-cresol) - Ampoule A7001 - Robust Z-Scores



Ordered Robust Z-Score Charts

Robust Z-Scores

2-nitrophenol
Results by Laboratory Code

Ampoule A7001				
Lab Code	Result ± MU ¹ (µg/L)		Robust z-score ²	Method Code ³
343	71.1	± 25.30	0.03	8
344	91.5	± 32.50	2.13	8
355	90.3	± 18.00	2.01	8
363	73	± 23.00	0.23	11
372	69.7	± 21.00	-0.11	11
385	70.8	± 10.60	0.00	8
396	69.4	± 12.00	-0.14	8
419	85	#	1.46	11
433	76.7	± 9.20	0.61	11
477	74.1	#	0.34	7
493	87.2	± 22.00	1.69	7
504	34.7	± 3.50	-3.72	§ 8
511	32.9	± 3.00	-3.90	§ 8
544	18.7	#	-5.37	§ 11
554	64.8	± 3.24	-0.62	8
559	49	#	-2.24	8
602	75.2	± 27.00	0.45	8
614	48.3	± 7.30	-2.32	7
633	60.9	± 17.00	-1.02	8
640	71.4	± 5.95	0.06	1
700	65	± 25.00	-0.60	8
808	74.1	± 7.00	0.34	8
821	68.5	± 24.00	-0.24	8
822	79.6	± 22.70	0.91	8

<i>No of Results:</i>	23
<i>Median:</i>	70.80
<i>Normalised IQR:</i>	9.71
<i>Robust CV:</i>	13.7%
<i>Minimum:</i>	19
<i>Maximum:</i>	92
<i>Range:</i>	72.8

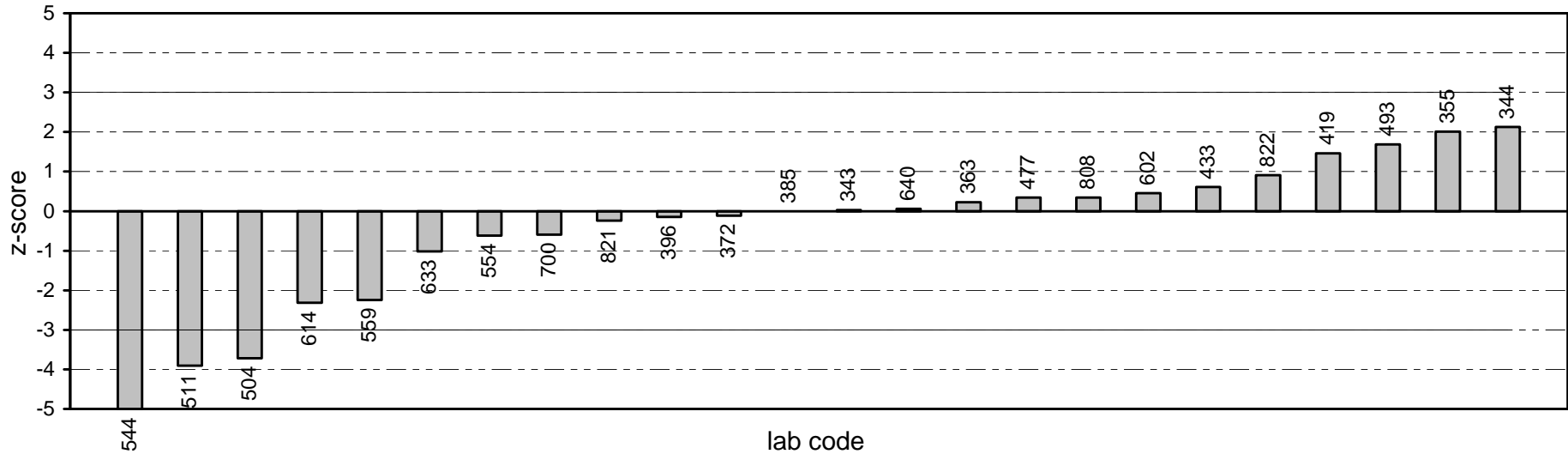
¹ Where reported, results are shown with their corresponding measurement uncertainty (MU).

² "§"s denote outliers (i.e. those results for which |z-score| > 3). Robust z-scores are calculated as: $z = (A - \text{median}) \div \text{normalised IQR}$, where, A is the participant laboratory's result.

³ Please refer to Appendix C (page C3) for method code descriptions.

⁴ A "#" indicates that no result/response was returned

2-nitrophenol - Ampoule A7001 - Robust Z-Scores



Robust Z-Scores

Ordered Robust Z-Score Charts

4-nitrophenol

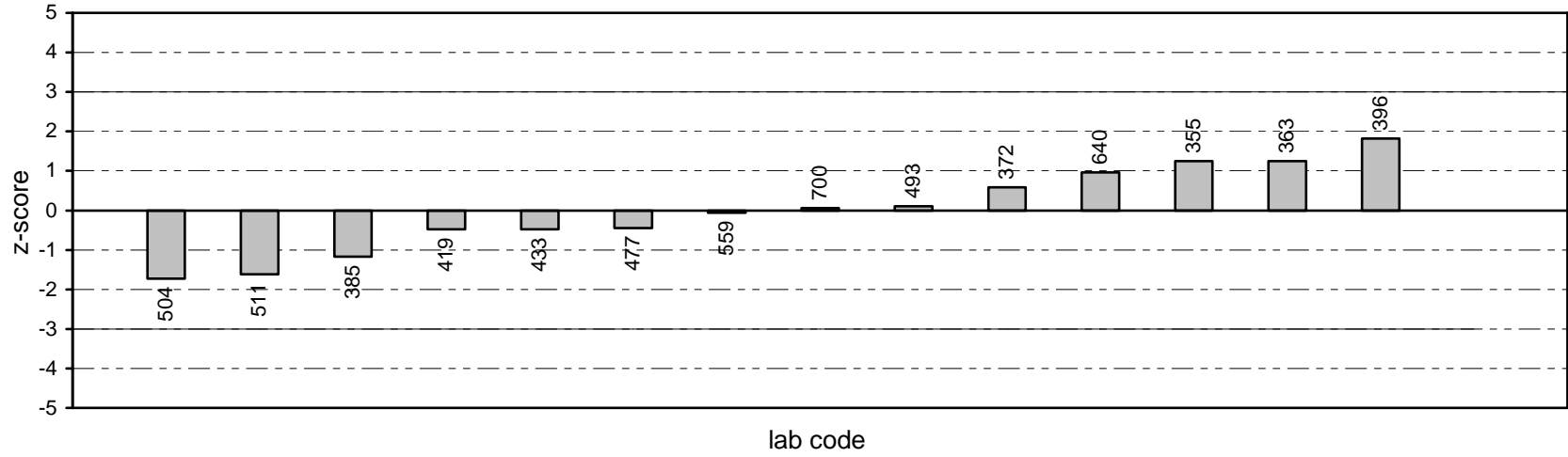
Results by Laboratory Code

Ampoule A7001				
Lab Code	Result ± MU ¹ (µg/L)		Robust z-score ²	Method Code ³
355	104	± 21.00	1.40	8
363	104	± 58.00	1.40	11
372	86.8	± 26.00	0.69	11
385	41	± 20.50	-1.19	8
396	119	± 14.00	2.02	8
419	59	#	-0.45	11
433	59	± 11.80	-0.45	11
477	59.8	#	-0.42	7
493	74.3	± 25.00	0.18	7
504	26.4	± 2.60	-1.80	8
511	29.3	± 3.00	-1.68	8
559	70	#	0.00	8
640	96.7	± 13.30	1.10	1
700	73	± 25.00	0.12	8
633 ⁵	<2	#		8
822 ⁵	<2	#		#

<i>No of Results:</i>	16
<i>Median:</i>	71.50
<i>Normalised IQR:</i>	26.11
<i>Robust CV:</i>	36.5%
<i>Minimum:</i>	26
<i>Maximum:</i>	119
<i>Range:</i>	92.6

- ¹ Where reported, results are shown with their corresponding measurement uncertainty (MU).
- ² "\$"s denote outliers (i.e. those results for which |z-score| > 3). Robust z-scores are calculated as: $z = (A - \text{median}) \div \text{normalised IQR}$, where, A is the participant laboratory's result.
- ³ Please refer to Appendix C (page C3) for method code descriptions.
- ⁴ A "#" indicates that no result/response was returned
- ⁵ These results were not included as part of statistical analysis and thus robust z-scores not calculated.

4-nitrophenol - Ampoule A7001 - Robust Z-Scores



Ordered Robust Z-Score Charts

Robust Z-Scores

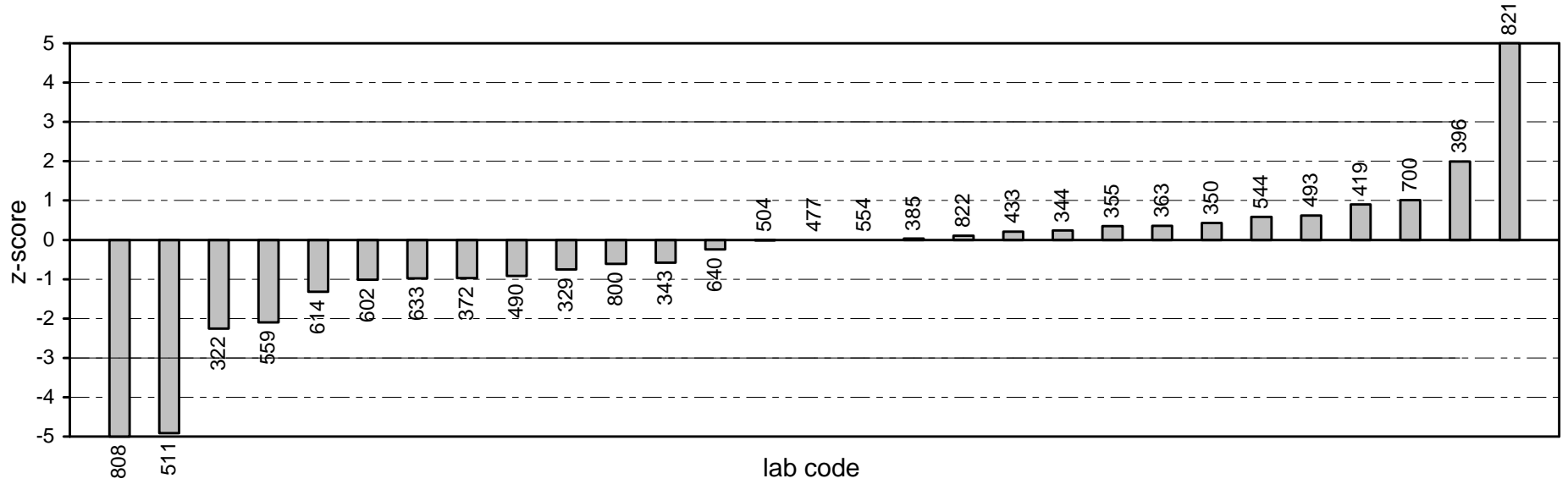
pentachlorophenol
Results by Laboratory Code

Lab Code	Ampoule A7001			Method Code ³
	Result ± MU ¹ (µg/L)		Robust z-score ²	
322	49	#	-2.26	8
329	62.8 ± 12.60		-0.75	11
343	64.4 ± 47.60		-0.58	8
344	71.9 ± 53.10		0.24	8
350	73.6 ± 16.70		0.43	8
355	72.9 ± 15.00		0.35	8
363	73 ± 23.00		0.36	11
372	60.8 ± 19.00		-0.97	11
385	70.0 ± 35.00		0.03	8
396	88 ± 3.00		1.99	8
419	78	#	0.90	11
433	71.6 ± 11.50		0.21	11
477	69.7	#	0.00	7
490	61.3 ± 0.20		-0.92	11
493	75.4 ± 12.00		0.62	7
504	69.6 ± 6.90		-0.01	8
511	24.6 ± 2.00		-4.92	§ 8
544	75.1	#	0.59	11
554	69.7 ± 8.49		0.00	8
559	50.5	#	-2.09	8
602	60.4 ± 42.00		-1.01	8
614	57.6 ± 6.20		-1.32	7
633	60.7 ± 24.00		-0.98	8
640	67.5 ± 16.70		-0.24	1
700	79 ± 25.00		1.01	8
800	64.1 ± 25.60		-0.61	8
808	19.8 ± 2.00		-5.44	§ 8
821	116 ± 86.00		5.05	§ 8
822	70.7 ± 27.80		0.11	8

No of Results: 28
 Median: 69.70
 Normalised IQR: 9.17
 Robust CV: 13.2%
 Minimum: 20
 Maximum: 116
 Range: 96.2

¹ Where reported, results are shown with their corresponding measurement uncertainty (MU).
² "§"s denote outliers (i.e. those results for which |z-score| > 3). Robust z-scores are calculated as: $z = (A - \text{median}) \div \text{normalised IQR}$, where, A is the participant laboratory's result.
³ Please refer to Appendix C (page C3) for method code descriptions.
⁴ A "#" indicates that no result/response was returned

pentachlorophenol - Ampoule A7001 - Robust Z-Scores



Ordered Robust Z-Score Charts

Robust Z-Scores

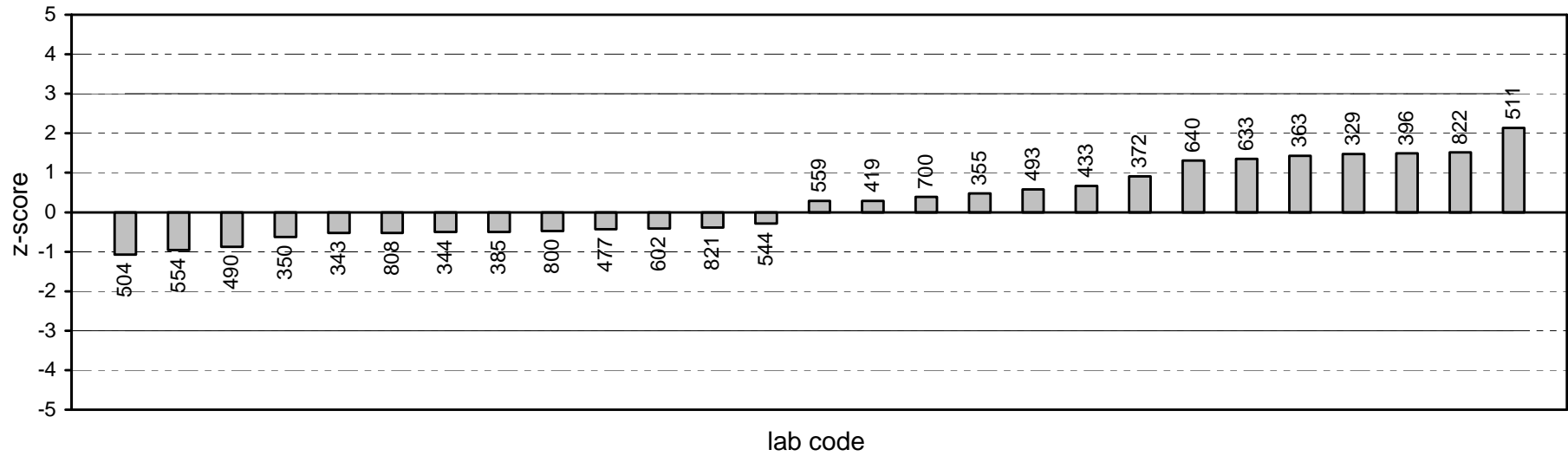
phenol
Results by Laboratory Code

Lab Code	Ampoule A7001			
	Result ± MU ¹ (µg/L)	Robust z-score ²	Method Code ³	
329	152 ± 30.40	1.47	11	
343	55.7 ± 25.50	-0.53	8	
344	57 ± 26.10	-0.50	8	
350	50.8 ± 7.01	-0.63	8	
355	104 ± 21.00	0.48	8	
363	150 ± 36.00	1.43	11	
366	*	*	*	
372	125 ± 33.00	0.91	11	
385	57 ± 28.50	-0.50	8	
396	153 ± 21.00	1.49	8	
419	95	#	11	
432	^	^	^	
433	113 ± 20.30	0.66	11	
477	60.3	#	7	
490	38.7 ± 0.20	-0.88	11	
493	109 ± 26.00	0.58	7	
504	29.4 ± 2.90	-1.07	8	
511	184 ± 2.00	2.14	8	
544	67.3	#	11	
554	34.8 ± 1.74	-0.96	8	
559	94.8	#	8	
602	61.2 ± 24.00	-0.41	8	
633	146 ± 33.00	1.35	8	
640	144 ± 10.30	1.31	1	
700	100 ± 25.00	0.39	8	
800	58 ± 18.80	-0.48	8	
808	55.7 ± 6.00	-0.53	8	
821	62.4 ± 29.00	-0.39	8	
822	154 ± 35.10	1.51	8	

No of Results:	28
Median:	81.05
Normalised IQR:	48.18
Robust CV:	59.5%
Minimum:	29
Maximum:	184
Range:	154.6

- ¹ Where reported, results are shown with their corresponding measurement uncertainty (MU).
- ² "\$"s denote outliers (i.e. those results for which |z-score| > 3). Robust z-scores are calculated as: $z = (A - \text{median}) \div \text{normalised IQR}$, where, A is the participant laboratory's result.
- ³ Please refer to Appendix C (page C3) for method code descriptions.
- ⁴ A "#" indicates that no result/response was returned
- ⁶ "*" result given is for total phenolic distilled thus not included in the statistical analysis.
- ⁷ "^" result given is for total phenols thus not included in the statistical analysis.

phenol - Ampoule A7001 - Robust Z-Scores



Ordered Robust Z-Score Charts

Robust Z-Scores

2,4,5-trichlorophenol
Results by Laboratory Code

Ampoule A7001					
Lab Code	Result ± MU ¹ (µg/L)		Robust z-score ²	Method Code ³	
322	45	#	-5.37	§	8
329	117 ±	23.40	0.15		11
343	121 ±	43.00	0.46		8
344	133.4 ±	47.90	1.41		8
355	154 ±	31.00	2.99		8
363	115 ±	37.00	0.00		11
372	110 ±	33.00	-0.38		11
385	118 ±	17.70	0.23		8
396	123 ±	15.00	0.61		8
419	116	#	0.08		11
477	109	#	-0.46		7
493	149 ±	22.00	2.61		7
504	70 ±	7.00	-3.45	§	8
511	76.6 ±	8.00	-2.94		8
544	53.1	#	-4.74	§	11
554	117.9 ±	5.90	0.22		8
559	131	#	1.23		8
602	99.8 ±	36.00	-1.17		8
633	107 ±	22.00	-0.61		8
640	101	#	-1.07		1
700	114 ±	25.00	-0.08		8
808	70.4 ±	9.00	-3.42	§	8
821	104 ±	37.00	-0.84		8
822	115 ±	24.00	0.00		8

<i>No of Results:</i>	23
<i>Median:</i>	115.00
<i>Normalised IQR:</i>	13.05
<i>Robust CV:</i>	11.3%
<i>Minimum:</i>	45
<i>Maximum:</i>	154
<i>Range:</i>	109

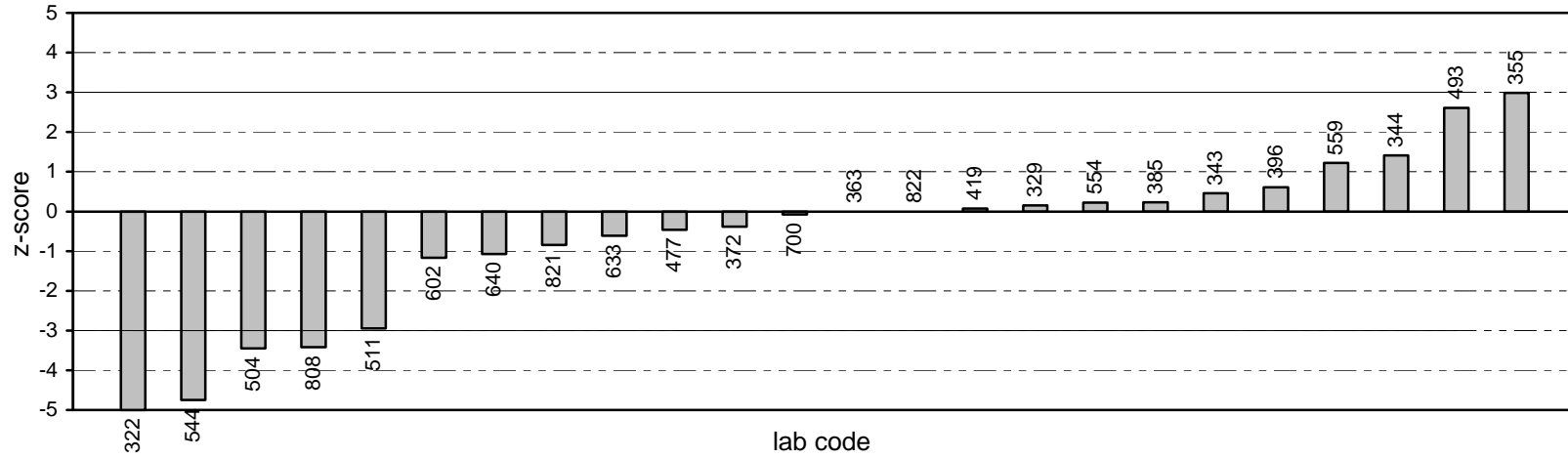
¹ Where reported, results are shown with their corresponding measurement uncertainty (MU).

² "§"s denote outliers (i.e. those results for which |z-score| > 3). Robust z-scores are calculated as: z = (A - median) ÷ normalised IQR, where, A is the participant laboratory's result.

³ Please refer to Appendix C (page C3) for method code descriptions.

⁴ A "#" indicates that no result/response was returned

2,4,5-trichlorophenol - Ampoule A7001 - Robust Z-Scores



Robust Z-Scores

Ordered Robust Z-Score Charts

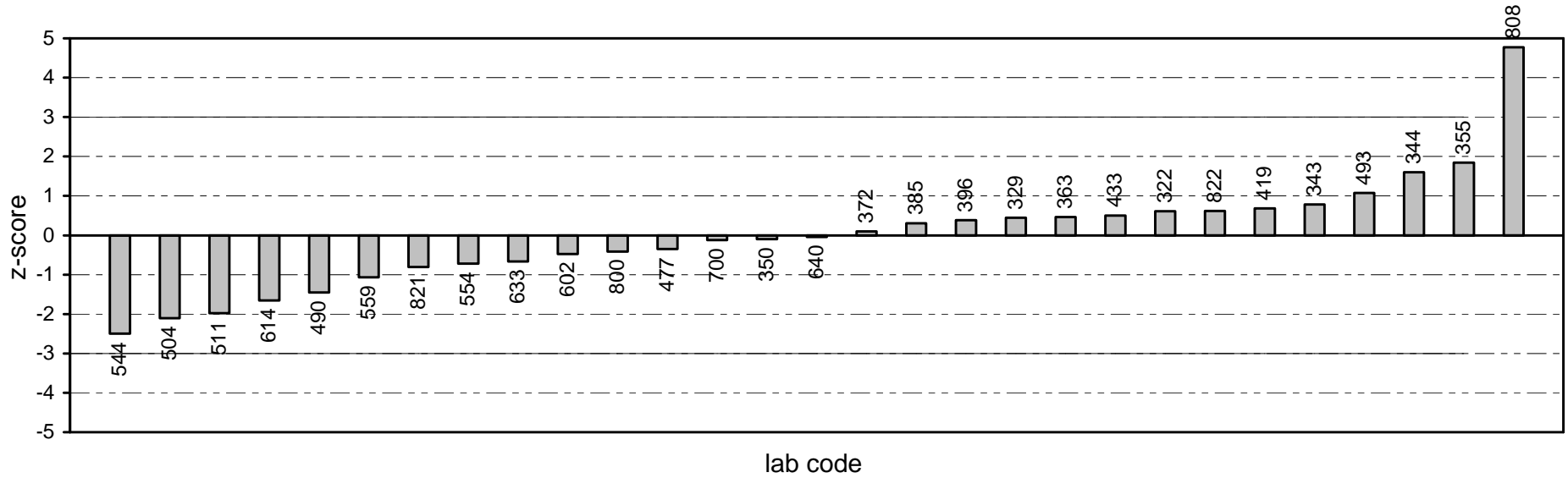
2,4,6-trichlorophenol
Results by Laboratory Code

Lab Code	Ampoule A7001			Method Code ³
	Result ± MU ¹ (µg/L)		Robust z-score ²	
322	77	#	0.61	8
329	74.8 ±	15.00	0.45	11
343	79.4 ±	23.70	0.78	8
344	90.6 ±	27.00	1.60	8
350	67.4 ±	4.31	-0.10	8
355	93.9 ±	19.00	1.84	8
363	75 ±	24.00	0.46	11
372	70 ±	22.00	0.10	11
385	72.8 ±	10.90	0.30	8
396	73.9 ±	8.00	0.38	8
419	78	#	0.68	11
433	75.5 ±	8.31	0.50	11
477	63.9	#	-0.35	7
490	48.9 ±	0.20	-1.45	11
493	83.4 ±	16.00	1.07	7
504	39.9 ±	4.00	-2.11	8
511	41.6 ±	4.00	-1.98	8
544	34.5	#	-2.50	11
554	58.9 ±	2.95	-0.72	8
559	54.1	#	-1.07	8
602	62.2 ±	17.00	-0.48	8
614	46 ±	4.10	-1.66	7
633	59.6 ±	14.00	-0.67	8
640	68.1 ±	5.37	-0.04	1
700	67 ±	25.00	-0.12	8
800	63.1 ±	15.90	-0.41	8
808	134 ±	13.00	4.77 §	8
821	57.7 ±	5.00	-0.80	8
822	77.2 ±	17.80	0.62	8

No of Results:	28
Median:	68.70
Normalised IQR:	13.68
Robust CV:	19.9%
Minimum:	35
Maximum:	134
Range:	99.5

¹ Where reported, results are shown with their corresponding measurement uncertainty (MU).
² "§"s denote outliers (i.e. those results for which |z-score| > 3). 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 (page C3) for method and digestion code descriptions.
⁴ A "#" indicates that no result/response was returned

2,4,6-trichlorophenol - Ampoule A7001 - Robust Z-Scores



Robust Z-Scores

Ordered Robust Z-Score Charts

APPENDIX B

Sample Homogeneity

Homogeneity Testing and Program Comparison Data

Samples for this program were obtained from the New York State Department of Health, Wadsworth centre for Laboratories and Research. This organisation is a NIST accredited provider. As such, all samples are subjected to rigorous stability and homogeneity testing. On the basis of this testing, the ampoules utilised for this program were considered to be homogeneous.

APPENDIX C

Documentation

Instructions to Participants C1
Method Codes C3
Results Sheet C4

PRIORITY POLLUTANT PHENOLS

INSTRUCTIONS TO PARTICIPANTS

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

1. Samples

- i) One sealed glass ampoule labelled A7001 supplied by the New York State Department of Health, Wadsworth Center for Laboratories and Research. The ampoule contains drinking water pesticides.
- ii) The ampoule will require 1,000-fold dilution in reagent grade water.

2. Sample Preparation

Caution: Analysis must begin immediately after ampoule is opened.

- i) Adjust ampoule temperature to 20° C
- ii) .Add approximately 900 millilitres (mL) reagent grade water to a one- litre volumetric flask.
- iii) Record ampoule ID number. Open ampoule by snapping the top off at the narrow area of the neck.
- iv) Using a 1.00 mL glass syringe transfer 1.00 millilitre (mL) from the ampoule into the flask.
- v) Bring to volume with reagent grade water.
- vi) Stopper and mix by inversion.

3. Tests Requested

For the sample prepared from the ampoule.

i) Priority pollutant phenols

(Analyse a reagent water blank by the same method used to analyse samples.)

Participants are requested to perform the tests for which NATA accreditation is held, using their accredited methods.

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 ampoules, prepared samples, other chemicals required for the analysis, and materials for disposal.
- iii) Use of safety glasses, gloves, and fume hoods, where appropriate during the determinations, is recommended.

5. Reporting

- (a) Report results using three significant figures. For compounds not found, report results using < preceding the laboratory's reporting limit.
 - (b) Report results in micrograms per litre ($\mu\text{g/L}$).
 - (c) Do not correct results for recovery
 - (d) In addition to reporting the results, record the method of analysis using the attached codes
 - (e) Laboratories are also requested to calculate and report an estimate of uncertainty measurement for each reported measurement result. All estimates of uncertainty of measurement must be given as a 95% confidence interval (coverage factor $k \approx 2$) and reported in $\mu\text{g/L}$
6. Testing should commence as soon as possible after receiving ampoules and results reported **NO LATER THAN 30 MARCH 2007 to:**

Ms Lexie Russell Proficiency Testing Australia PO Box 1122 ARCHERFIELD BC QLD 4108 AUSTRALIA Phone: +617 3721 7373 Fax: +617 3217 1844 Email: lrussell@nata.asn.au
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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.

Method Codes to be used for the Results Sheet

ANALYSIS	METHOD DESCRIPTION	METHOD REFERENCE	CODE
4 – chloro – 3 methylphenol 2 – chlorophenol 2,4 – dichlorophenol 2,4 – dimethylphenol 2,4 – dinitrophenol	GC	SM19, SM20, SM21 (6420B)	1
		SM21 (6640B)	2
		40 CFR, Part 136, Oct 26 1984 (604)	3
		SM21 (6251B)	4
		USEPA 8041	5
		Other (please specify)	6
2 – methyl – 4,6 – dinitrophenol 2 – methylphenol (o – cresol) 4 – methylphenol (p – cresol) 2 – nitrophenol 4 nitrophenol Pentachlorophenol Phenol 2,4,5 – trichlorophenol 2,4,6 - trichlorophenol	GC/MS	SM19, SM20, SM21 (6410B)	7
		USEPA 8270C	8
		40CFR, Part 136, Oct 26, 1984 (625)	9
		40CFR, Part 136, Oct 26, 1984 (1625)	10
		Other (please specify)	11

1

Method Reference Key

- (a) SM19, SM20, SM21 APHA “Standard Methods for the Examination of Water and Wastewater” 19th Edition (1995), 20th Edition (1998), 21st Edition (2005)
- (b) USEPA USEPA SW-846
- (c) 40CFR Part 136 OCT 26, 1984
“Part V111 Environmental Protection Agency, 40 CFR, Part 136, Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act; Final; Rule and Interim, Final Rule and Proposed Rule”, Oct 26, 1984

**WATERS PROFICIENCY TESTING PROGRAM
CHEMICAL ANALYSIS SUB-PROGRAM 92**

**PRIORITY POLLUTANT PHENOLS MARCH 2007
RESULTS SHEET (µg/L)**

Laboratory
Code

75

ANALYSIS	AMPOULE A7001		METHOD CODE
	Result	±MU*	
4 – chloro – 3 methylphenol			
2 – chlorophenol			
2,4 – dichlorophenol			
2,4 – dimethylphenol			
2,4 – dinitrophenol			
2 – methyl – 4,6 – dinitrophenol			
2 – methylphenol (o – cresol)			
4 – methylphenol (p – cresol)			
2 – nitrophenol			
4 nitrophenol			
Pentachlorophenol			
Phenol			
2,4,5 – trichlorophenol			
2,4,6 - trichlorophenol			

- (a) For the prepared sample (diluted from the ampoule) only a single result is requested for each analyte.
 (b) Report results using three significant figures. For compounds not found, report results using < preceding the laboratory's reporting limit
 (c) Report results in micrograms per litre (µg/L)
 (d) Do not correct results for recovery
 (e) MU* Laboratories Measurement Uncertainty (MU) if known for the result. Please report µg/L

DATE

SIGNATURE

Return results NO LATER THAN 30 MARCH 2007 to Ms. Lexie Russell Proficiency Testing Australia PO Box 1122 ARCHERFIELD BC QLD 4108 AUSTRALIA	Phone: +612 9736 8397 Fax: +612 9743 6664 Email: lrussell@pta.asn.au
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