

Report No. 1124

Concrete Proficiency Testing Program

Round 25

February 2019

Acknowledgments

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1. FOREWORD

This report summarises the results of a proficiency testing program on the determination of Density and Compressive Strength of hardened concrete cylinders. It constitutes the twenty-fifth round of an ongoing series of programs. This program is accredited to ISO/IEC 17043:2010 “*Conformity assessment - General requirements for proficiency testing*” by International Accreditation New Zealand (IANZ).

The program was conducted in November-December 2018 by Proficiency Testing Australia (PTA). The aim of the program was to assess laboratories’ abilities to competently perform the prescribed analyses.

The Program Coordinator was Dr E Cincu and the Technical Adviser was Mr M McCarthy from Soil Engineering Services, Townsville, QLD. This report was authorised by Mrs K Cividin, PTA Quality Manager.

2. FEATURES OF THE PROGRAM

- (a) Participants were provided with two concrete cylinders labelled PTA 1 and PTA 2.
- (b) A total of 67 laboratories received samples, comprising of:
 - 52 Australian participants; and
 - 15 overseas participants, including:
 - Botswana (1);
 - Chile (2);
 - Hashemite Kingdom of Jordan (1);
 - Malaysia (2);
 - Mauritius (1);
 - New Zealand (3);
 - Papua New Guinea (1);
 - Philippines (2);
 - Qatar (1); and
 - South Korea (1).

One laboratory was unable to submit all results by the due date.

- (c) 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 and to record their results on the *Results Sheet*.

- (d) Prior to sample distribution, a number of randomly selected samples were analysed for homogeneity. Based on the results of this testing (see Appendix B), the homogeneity of the samples was established.
- (e) 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.
- (f) Results (as reported by participants) with corresponding summary statistics (i.e. number of results, median, uncertainty of the median, normalised interquartile range, robust coefficient of variation, minimum, maximum and range) are presented in Appendix A.
- (g) A robust statistical approach, using z-scores, was utilised to assess laboratories' testing performance (see Section 4). Robust z-scores and z-score charts for Mass/Volume and Compressive Strength are presented in Appendix A.
- (h) 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.
- (i) A tabulated listing of laboratories (by code number) identified as having outlier results can be found on page no. 7.

3. FORMAT OF THE APPENDICES

- (a) Appendix A contains the analysis of results reported by laboratories for the samples. This section contains the following for each determinant, where appropriate:
 - a table of results and calculated z-scores;
 - a list of summary statistics; and
 - ordered z-score charts.
- (b) Appendix B contains details of the homogeneity testing.
- (c) Appendix C contains copies of the *Instructions to Participants and Results Sheet*.

4. STATISTICAL DESIGN OF THE PROGRAM

- (a) 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 or equal to 3.0 is considered to be an outlier and is marked by the symbol "§".

The table on page no. 7 summarises the outlier results detected.

(b) Results Tables and Summary Statistics

Each of these tables contains the results returned by each laboratory and where applicable, 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 the tables of results for Mass/Volume 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 uncertainty of the median; a robust estimate of the standard deviation of the *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 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:

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

n = number of results

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

(c) 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 +3.0 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.

The following table summarises the results submitted by participants for the program.

TABLE A-1: SUMMARY STATISTICS

Test	No. of Results	Minimum	Maximum
Height - PTA 1 (Nearest 1 mm)	82	194	201
Height - PTA 2 (Nearest 1 mm)	82	196	201
Diameter PTA 1 (Nearest 0.2 mm)	82	97.10	100.50
Diameter PTA 2 (Nearest 0.2 mm)	82	97.00	103.00
Weight PTA 1 (Nearest 1 g)	82	3540	3665
Weight PTA 2 (Nearest 1 g)	82	3554	3664
Maximum Sustained Load Unit PTA 1 (Nearest 1 kN)	82	190.0	443.0
Maximum Sustained Load Unit PTA 2 (Nearest 1 kN)	82	170.0	489.0

TABLE A-2: SUMMARY STATISTICS

Test	No. of Results	Median	Normalised IQR	Robust CV (%)
Mass/Volume PTA 1 (Nearest 1 kg/m ³)	82	2316.0	8.9	0.4%
Mass/Volume PTA 2 (Nearest 1 kg/m ³)	82	2312.0	12.6	0.5%
Compressive Strength PTA 1 (Nearest 0.5 MPa)	82	50.50	2.59	5.1%
Compressive Strength PTA 2 (Nearest 0.5 MPa)	82	53.05	3.24	6.1%

5. PTA AND TECHNICAL ADVISER'S COMMENTS

A total of 67 laboratories (42 Australian and 15 overseas) participated in this round. One laboratory did not submit all results in time for inclusion in the final report.

Overall performance against prior expectations

In total 26 outliers were detected from the 328 results analysed, resulting in 7.9% of results classified as outliers which was similar to previous rounds. Overall, a satisfactory performance was achieved in this round, with a low percentage of outliers.

All laboratories with outliers (“§”) or an absolute z-score between 2.0 and 3.0 (“?”) are encouraged to review their procedures.

Participants should take care with calculations and when recording results on the provided Results Sheet.

Variations between laboratories

Table B gives a comparison of the robust CVs for tests common to previous programs. The CV values for all tests and cylinders are within the limits observed in previous rounds.

Variations between test methods and procedures

The majority of participants performed the required testing using AS 1012.9 and AS 1012.12.1. Other test methods used include ASTM C39/C39M-18, BS EN 12390-3 and NZS 3112. It has been determined that no major differences exist between the methods, therefore the results were pooled for analysis.

Possible sources of error and suggestions for improvement

Possible sources of error that may affect the outcome of the proficiency testing program include, but are not limited to:

- the condition of the concrete specimens (damage during dispatch, late testing)
- interpretation of test methods and procedures
- calibration of laboratory instruments
- incorrect calculations
- mistakes whilst recording the results on the Results Sheet

Participants may consider the following when performing corrective action investigations:

- training of technicians
- calibration of equipment
- review of methods and procedures
- ground end inspection checked daily, randomly or 1 in 20 specimen checks
- precision in reporting and calculations

Participants could also perform internal proficiency tests under senior supervision to isolate any anomalies found.

TABLE B: COMPARISON OF PREVIOUS ROUND CVs

Test	Round 20	Round 21	Round 22	Round 23	Round 24	Round 25
Mass/Volume PTA 1	0.5%	0.5%	0.7%	0.5%	0.5%	0.4%
Mass/Volume PTA 2	0.7%	0.5%	0.1%	0.6%	0.3%	0.5%
Compressive Strength PTA 1	4.2%	4.8%	5.7%	6.5%	9.8%	5.1%
Compressive Strength PTA 2	4.4%	4.7%	6.8%	5.5%	10.9%	6.1%

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.

As the assigned value for this program is the median of the results submitted by the participants, the uncertainty of the median has been calculated and is presented in Appendix A.

Sample preparation was undertaken according to the Standard Operating Procedures of Soil Engineering Services to ensure samples were homogeneous and appropriate for the program. Please refer to Appendix B for homogeneity results.

Analysis of Results by Method Groups

In order for methods to be grouped for analysis, PTA requires at least 11 sets of results from the same method group. Therefore, further analysis of results by Method AS 1012.9 was undertaken to provide specific information on individual method performance for Compressive Strength. Table C below presents the Median, Uncertainty of the Median and Robust CV of the results obtained by this method.

TABLE C: SUMMARY OF GROUP ANALYSIS

Test	Method	Sample	Number of Results	Median	Uncertainty of the Median	Robust CV
Compressive Strength (Nearest 0.5 MPa)	AS 1012.9	PTA 1	41	51.00	0.51	5.1%
		PTA 2	41	53.50	0.58	5.5%

6. OUTLIER RESULTS

Laboratories reporting outlier results are listed in the following table:

TABLE D: SUMMARY OF STATISTICAL OUTLIERS

Test	Laboratory Code No.
Mass/Volume PTA 1	38, 44A, 52A, 86A, 86B, 86C and 102
Mass/Volume PTA 2	8, 44A, 54 and 86A
Compressive Strength PTA 1	8, 11A, 44A, 44B, 60, 107 and 109
Compressive Strength PTA 2	8, 44A, 44B, 54, 60, 102, 107 and 109

**TABLE E: COMPARISON OF PREVIOUS ROUNDS
PERCENTAGE OF OUTLIERS**

Test	Round 20	Round 21	Round 22	Round 23	Round 24	Round 25
Mass/Volume PTA 1	11.5%	5.9%	5%	4.8%	0%	8.5%
Mass/Volume PTA 2	9.6%	3.9%	3.3%	6%	9.6%	4.8%
Compressive Strength PTA 1	5.7%	7.8%	8.3%	5.9%	12.9%	8.5%
Compressive Strength PTA 2	9.4%	5.9%	8.3%	5.9%	6.4%	9.7%

7. REFERENCES

- [1] *Guide to Proficiency Testing Australia*, 2016 (This document can be found on the PTA website, www.pta.asn.au)
- [2] AS 1012.9:2014 *Methods for testing concrete. Compressive strength tests - Concrete, mortar and grout specimens*
- [3] AS 1012.12.1:1998 (R2014) *Methods of testing concrete. Determination of mass per unit volume of hardened concrete - Rapid measuring method*
- [4] ASTM C39/C39M-18 *Standard test method for compressive strength of cylindrical concrete specimens*
- [5] BS EN 12390-3:2009 *Testing hardened concrete. Compressive strength of test specimens*
- [6] NZS 3112.2:2000 *Methods of test for concrete - Tests related to determination of strength of concrete*

APPENDIX A

Results and Data Analysis

Height.....	A1
Diameter.....	A3
Weight.....	A6
Mass/Volume.....	A9
Maximum Sustained Load Unit.....	A17
Compressive Strength.....	A20
Additional Information.....	A28

Lab Code	Height (Nearest 1 mm)	
	PTA 1	PTA2
2A	197	196
2B	197	196
2C	200	200
4	200	199
6	200	200
7	198	196
8	201	199
11A	199	199
11B	196	196
14	200	199
15	198	197
16A	201	199.0
16B	199	199
16C	199.00	199.00
17	198	197
18	199	199
21	200	200
22A	200	200
22B	200	199
23	199	200
25	199	199
26	200	200
28	199	199
29	194	196
30A	197	198
30B	198	196
31	200	199
33	199	198
35	199	199
36	200	200
37	199	196
38	196	197
39	200	198
40A	199	198
40B	200	199
44A	197	196
44B	200	199
45	200	198
46	200	200
48	200	200
49	199	199
51	200	200
52A	200	199

Lab Code	Height (Nearest 1 mm)	
	PTA 1	PTA2
52B	200	199
53	200	200
54	198	199
56	199	200
58	199	200
60	200	200
61	198	198
62	200	199
64	200	198
66	201	200
67	196.0	197.0
70B	195	196
70C	195	197
71	200	200
73	200	198
74	199	200
76	200.0	200.0
79	200	200
85	199	199
86A	197	196
86B	196	197
86C	198	197
87	199	198
90	199	200
91A	196	196
91B	196	197
92	200	199
94	200	199
96	199	199
97	199	200
98	197	197
99	200	201
100	199	200
102	200	200
106	200	198
107	200	199
109	199	199
110A	198	198
110B	200	199

No. of Results	82	82
Minimum	194	196
Maximum	201	201

Lab Code	Diameter PTA 1 (Nearest 0.2 mm)		
	Result 1	Result 2	Average
2A	100.0	100.2	100.10
2B	100.0	100.2	100.10
2C	99.8	100.0	99.90
4	100.0	100.0	100.00
6	100.0	100.2	100.10
7	100.4	100.2	100.30
8	100	100	100.00
11A	100.2	100.0	100.10
11B	99.8	99.8	99.80
14	100.4	100.4	100.40
15	100.2	100.2	100.20
16A	99.8	100.0	99.90
16B	100.0	100.0	100.00
16C	100.20	100.40	100.30
17	99.8	99.8	99.80
18	99.8	100.2	100.00
21	100.0	100.4	100.20
22A	100.4	100.0	100.20
22B	100.0	100.2	100.10
23	100.0	100.0	100.00
25	100.4	100.2	100.30
26	100.0	100.0	100.00
28	99.8	100.2	100.00
29	100.2	100.2	100.20
30A	100.2	99.8	100.00
30B	100.2	100	100.10
31	100.0	100.4	100.20
33	100.4	99.8	100.10
35	100.0	100.4	100.20
36	100.0	100.4	100.20
37	100.4	100.6	100.50
38	100.0	100.2	100.10
39	100.0	100.0	100.00
40A	99.4	100.4	99.90
40B	99.8	100.2	100.00
44A	97.2	97.0	97.10
44B	100.2	100.0	100.10
45	100.2	100.4	100.30
46	100.2	100.0	100.10
48	100.0	100.0	100.00
49	100.2	100.1	100.15

Lab Code	Diameter PTA 2 (Nearest 0.2 mm)		
	Result 1	Result 2	Average
2A	100.0	100.2	100.10
2B	100.0	100.2	100.10
2C	100.0	100.0	100.00
4	100.2	100.2	100.20
6	99.8	100.4	100.10
7	100.2	100.2	100.20
8	98	100	99.00
11A	100.4	99.8	100.10
11B	100.0	100.0	100.00
14	100.4	100.4	100.40
15	100.2	100.2	100.20
16A	100.2	100.2	100.20
16B	100.2	100.2	100.20
16C	100.40	100.00	100.20
17	99.8	99.6	99.70
18	100.4	100.0	100.20
21	100.4	100.4	100.40
22A	100.0	100.2	100.10
22B	100.0	100.0	100.00
23	100.0	100.2	100.10
25	100.4	100	100.20
26	100.0	100.0	100.00
28	99.8	100.4	100.10
29	100.0	100.2	100.10
30A	99.8	100.4	100.10
30B	100	100	100.00
31	100.4	100.4	100.40
33	100.4	99.8	100.10
35	100.0	100.6	100.30
36	100.4	100.2	100.30
37	100.6	100.4	100.50
38	100.0	100.4	100.20
39	100.0	99.8	99.90
40A	99.8	100.4	100.10
40B	99.6	100.2	99.90
44A	97	97	97.00
44B	100.4	100.4	100.40
45	99.6	99.8	99.70
46	100.4	100.0	100.20
48	100.0	100.0	100.00
49	100	100.1	100.05

Lab Code	Diameter PTA 1 (Nearest 0.2 mm)		
	Result 1	Result 2	Average
51	99.9	100.1	100.00
52A	99.6	99.6	99.60
52B	99.6	99.6	99.60
53	100.0	100.0	100.00
54	99.9	100.2	100.05
56	99.8	100.1	99.95
58	100	100.6	100.30
60	100.3	100.0	100.15
61	100.6	99.8	100.20
62	99.8	100.0	99.90
64	100.2	99.9	100.05
66	100.6	100.4	100.50
67	100.2	100.6	100.40
70B	100.4	100.4	100.40
70C	100.2	100.2	100.20
71	100.0	100.0	100.00
73	100.2	100.3	100.25
74	100.2	100.0	100.10
76	100.4	100.4	100.40
79	100.2	100.2	100.20
85	100	100	100.00
86A	99.8	100.0	99.90
86B	99.6	100.0	99.80
86C	99.8	100.2	100.00
87	100	99.8	99.90
90	100.2	100.0	100.10
91A	99.8	99.8	99.80
91B	100	100.2	100.10
92	99.8	100.2	100.00
94	100.2	100.3	100.25
96	100.2	100.0	100.10
97	100.0	100.6	100.30
98	100.0	100.2	100.10
99	100.4	100.2	100.30
100	100.2	100.2	100.20
102	100.0	100.0	100.00
106	100.4	99.8	100.10
107	100.0	100.0	100.00
109	100.2	100.1	100.15
110A	100.4	100.4	100.40
110B	100.2	100.2	100.20

Lab Code	Diameter PTA 2 (Nearest 0.2 mm)		
	Result 1	Result 2	Average
51	99.9	100.2	100.05
52A	100.00	99.8	99.90
52B	99.8	99.8	99.80
53	100.0	99.8	99.90
54	102.0	104.0	103.00
56	99.9	99.8	99.85
58	100	100.6	100.30
60	100.2	100.0	100.10
61	100.6	99.8	100.20
62	100.2	99.8	100.00
64	100.1	100.0	100.05
66	100.2	100.4	100.30
67	100.4	100.6	100.50
70B	100.0	100.0	100.00
70C	100.2	100.4	100.30
71	100.0	100.0	100.00
73	100.1	100.5	100.30
74	99.6	100.0	99.80
76	100.0	100.2	100.10
79	100.4	100.4	100.40
85	100	100	100.00
86A	99.4	100.0	99.70
86B	99.8	100.2	100.00
86C	99.6	100.2	99.90
87	100	99.8	99.90
90	100.0	100.2	100.10
91A	100.0	100.2	100.10
91B	99.8	100	99.90
92	99.8	100.4	100.10
94	100.2	100.0	100.10
96	100.2	100.4	100.30
97	99.8	100.4	100.10
98	100.0	100.2	100.10
99	100.4	100.2	100.30
100	100.2	100.0	100.10
102	100.0	100.0	100.00
106	100.2	100.0	100.10
107	100.0	100.0	100.00
109	100.1	100.1	100.10
110A	100.4	100.4	100.40
110B	100.4	100.4	100.40

Diameter PTA 1 (Nearest 0.2 mm)	
No. of Results	82
Minimum	97.10
Maximum	100.50

Diameter PTA 2 (Nearest 0.2 mm)	
No. of Results	82
Minimum	97.00
Maximum	103.00

Lab Code	Weight (Nearest 1 g)	
	PTA 1	PTA 2
2A	3593	3576
2B	3575	3564
2C	3637	3634
4	3632	3624
6	3643	3664
7	3609	3554
8	3647	3620
11A	3625	3621
11B	3573	3585
14	3646	3638
15	3614	3613
16A	3665	3617
16B	3627	3624
16C	3618.0	3625.0
17	3610	3570
18	3630	3620
21	3641	3624
22A	3634	3627
22B	3661	3619
23	3627	3625
25	3629	3630
26	3644	3636
28	3620	3626
29	3540	3578
30A	3600	3611
30B	3614	3583
31	3649	3617
33	3633	3620
35	3617	3632
36	3636	3627
37	3649	3607
38	3625	3630
39	3622	3623
40A	3625	3613
40B	3625	3616
44A	3635.9	3615.1
44B	3633	3610
45	3631	3617
46	3641	3628
48	3642	3638
49	3613	3630

Lab Code	Weight (Nearest 1 g)	
	PTA 1	PTA 2
51	3636	3628
52A	3651	3627
52B	3649	3613
53	3640	3609
54	3634	3615
56	3633	3617
58	3628.0	3642
60	3646	3621
61	3617	3605
62	3623	3628
64	3645	3625
66	3655	3624
67	3587.0	3597.0
70B	3550	3570
70C	3581	3592
71	3645	3621
73	3643	3620
74	3632	3608
76	#	#
79	3624	3628
85	3595	3581
86A	3626	3621
86B	3629	3633
86C	3646	3627
87	3619	3600
90	3622	3632
91A	3588	3585
91B	3594	3599
92	3632	3635
94	3657	3622
96	3632	3636
97	3629	3627
98	3593	3578
99	3654	3624
100	3627	3619
102	3596	3581
106	3652	3630
107	3629	3640
109	3601	3595
110A	3628	3616
110B	3648	3626

Weight (Nearest 1 g)		
	PTA 1	PTA 2
No. of Results	82	82
Minimum	3540	3554
Maximum	3665	3664

"#" indicates no response was provided by the laboratory

Lab Code	Mass/Volume (Nearest 1 kg/m ³)		
	PTA 1	Z-Score	
2A	2317	0.11	
2B	2306	-1.12	
2C	2320	0.45	
4	2312	-0.45	
6	2310	-0.67	
7	2300	-1.80	
8	2310	-0.67	
11A	2315	-0.11	
11B	2330	1.57	
14	2303	-1.46	
15	2320	0.45	
16A	2326	1.12	
16B	2320	0.45	
16C	2301	-1.69	
17	2332	1.80	
18	2323	0.79	
21	2309	-0.79	
22A	2309	-0.79	
22B	2327	1.24	
23	2320	0.45	
25	2308	-0.90	
26	2320	0.45	
28	2316	0.00	
29	2320	0.45	
30A	2327	1.24	
30B	2319	0.34	
31	2314	-0.22	
33	2320	0.45	
35	2318	0.22	
36	2300	-1.80	
37	2310	-0.67	
38	2350.14	3.84	§
39	2305	-1.24	
40A	2329	1.46	
40B	2326	1.12	
44A	2497	20.35	§
44B	2308	-0.90	
45	2298	-2.02	?
46	2313	-0.34	
48	2319	0.34	
49	2305	-1.24	

Lab Code	Mass/Volume (Nearest 1 kg/m ³)		
	PTA 1	Z-Score	
51	2310	-0.67	
52A	2343	3.04	§
52B	2342	2.92	?
53	2321	0.56	
54	2332	1.80	
56	2314	-0.22	
58	2305	-1.24	
60	2320	0.45	
61	2316	0.00	
62	2311	-0.56	
64	2318	0.22	
66	2293	-2.59	?
67	2312	-0.45	
70B	2301	-1.69	
70C	2330	1.57	
71	2320	0.45	
73	2307	-1.01	
74	2319	0.34	
76	#	na	
79	2299	-1.91	
85	2300	-1.80	
86A	2348	3.60	§
86B	2368	5.85	§
86C	2346	3.37	§
87	2320	0.45	
90	2310	-0.67	
91A	2340	2.70	?
91B	2330	1.57	
92	2312	-0.45	
94	2320	0.45	
96	2319	0.34	
97	2308	-0.90	
98	2318	0.22	
99	2312	-0.45	
100	2310	-0.67	
102	2289	-3.04	§
106	2323	0.79	
107	2310	-0.67	
109	2293	-2.59	?
110A	2314	-0.22	
110B	2313	-0.34	

Mass/Volume PTA 1 (Nearest 1 kg/m³)	
No. of Results	82
Median	2316.0
Normalised IQR	8.9
Uncertainty of the Median	1.2
Robust CV	0.4%
Minimum	2289
Maximum	2497
Range	208

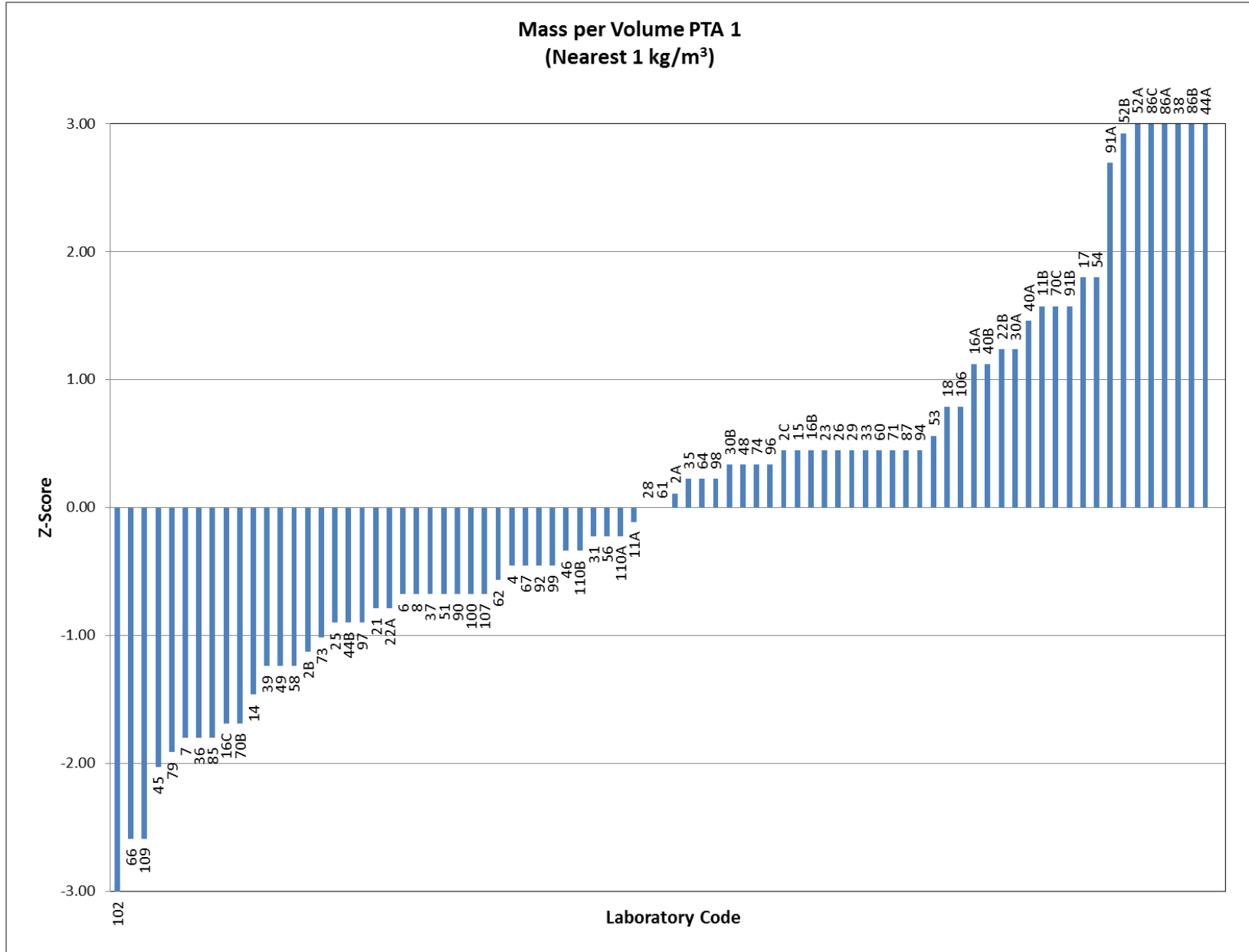
Notes:

"?" indicates an absolute z-score greater than 2.0 but less than 3, i.e. $2.0 < |z\text{-score}| < 3.0$

"§" indicates an outlier, i.e. $|z\text{-score}| \geq 3.0$

"#" indicates no response was provided by the laboratory

"na" indicates not applicable



Lab Code	Mass/Volume (Nearest 1 kg/m ³)		
	PTA 2	Z-Score	
2A	2318	0.48	
2B	2311	-0.08	
2C	2310	-0.16	
4	2309	-0.24	
6	2323	0.87	
7	2300	-0.95	
8	2363	4.05	§
11A	2312	0.00	
11B	2329	1.35	
14	2309	-0.24	
15	2320	0.63	
16A	2305	-0.56	
16B	2310	-0.16	
16C	2310	-0.16	
17	2322	0.79	
18	2307	-0.40	
21	2289	-1.83	
22A	2309	-0.24	
22B	2317	0.40	
23	2303	-0.71	
25	2313	0.08	
26	2315	0.24	
28	2315	0.24	
29	2323	0.87	
30A	2317	0.40	
30B	2323	0.87	
31	2296	-1.27	
33	2323	0.87	
35	2310	-0.16	
36	2300	-0.95	
37	2320	0.63	
38	2336.77	1.97	
39	2333	1.67	
40A	2321	0.71	
40B	2326	1.11	
44A	2497	14.68	§
44B	2291	-1.67	
45	2340	2.22	?
46	2309	-0.24	
48	2316	0.32	
49	2320	0.63	
51	2310	-0.16	

Lab Code	Mass/Volume (Nearest 1 kg/m ³)		
	PTA 2	Z-Score	
52A	2325	1.03	
52B	2321	0.71	
53	2306	-0.48	
54	2180	-10.47	§
56	2303	-0.71	
58	2305	-0.56	
60	2300	-0.95	
61	2309	-0.24	
62	2321	0.71	
64	2329	1.35	
66	2295	-1.35	
67	2302	-0.79	
70B	2320	0.63	
70C	2309	-0.24	
71	2305	-0.56	
73	2313	0.08	
74	2306	-0.48	
76	#	na	
79	2292	-1.59	
85	2291	-1.67	
86A	2369	4.52	§
86B	2349	2.94	?
86C	2349	2.94	?
87	2320	0.63	
90	2310	-0.16	
91A	2324	0.95	
91B	2331	1.51	
92	2321	0.71	
94	2320	0.63	
96	2312	0.00	
97	2304	-0.63	
98	2308	-0.32	
99	2281	-2.46	?
100	2300	-0.95	
102	2280	-2.54	?
106	2325	1.03	
107	2329	1.35	
109	2299	-1.03	
110A	2306	-0.48	
110B	2302	-0.79	

Mass/Volume PTA 2 (Nearest 1 kg/m³)	
No. of Results	82
Median	2312.0
Normalised IQR	12.6
Uncertainty of the Median	1.7
Robust CV	0.5%
Minimum	2180
Maximum	2497
Range	317

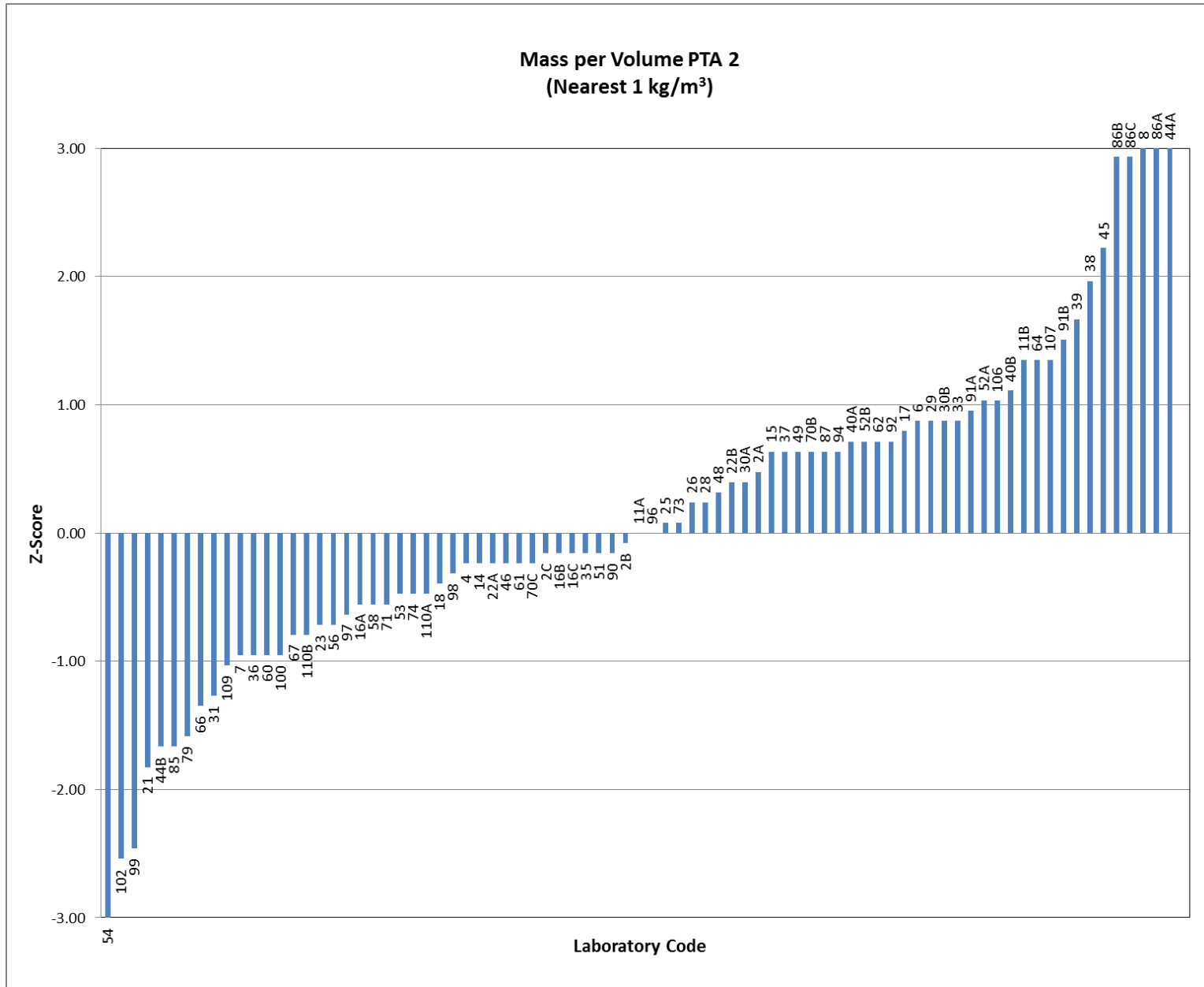
Notes:

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"§" indicates an outlier, i.e. $|z\text{-score}| \geq 3.0$

"#" indicates no response was provided by the laboratory

"na" indicates not applicable



Lab Code	Maximum Sustained Load Unit (Nearest 1 kN)	
	PTA 1	PTA 2
2A	389	411
2B	378	430
2C	390	396
4	370	394
6	400	458
7	412	432
8	190	170
11A	279	460
11B	412	416
14	400	360
15	416	421
16A	385	446
16B	386	414
16C	398.00	427.0
17	417	451
18	397	410
21	389	417
22A	402	413
22B	388	428
23	396	401
25	436	489
26	397	389
28	400	415
29	404	405
30A	409	407
30B	417	429
31	425	469
33	388	424
35	402	430
36	392.3	366.4
37	408	393
38	414.0	420.4
39	406	424
40A	349	403
40B	372	392
44A	291	216
44B	283	276
45	404	418
46	386	428
48	404	390
49	394.5	410.3
51	397.2	414.8

Lab Code	Maximum Sustained Load Unit (Nearest 1 kN)	
	PTA 1	PTA 2
52A	399	445
52B	395	448
53	389	424
54	363	339
56	439	417
58	382	429
60	308	309
61	404	446
62	383	452
64	386	421
66	404	436
67	403	445
70B	423	401
70C	443	403
71	393.0	431.0
73	350	372
74	408	431
76	376	349
79	379	419
85	379.3	412.4
86A	373	438
86B	409	427
86C	399	443
87	397.2	427
90	388	399
91A	411	435
91B	405	439
92	402	402
94	367	412
96	374	420
97	384	389
98	420	432
99	383	370
100	400	436
102	338	304
106	379.1	459.7
107	319	330
109	296	285
110A	391	426
110B	414	449

Maximum Sustained Load Unit (Nearest 1 kN)		
	PTA 1	PTA 2
No. of Results	82	82
Minimum	190.0	170.0
Maximum	443.0	489.0

Lab Code	Compressive Strength (Nearest 0.5 MPa)		
	PTA 1	Z-Score	
2A	49.5	-0.39	
2B	48.0	-0.96	
2C	50.0	-0.19	
4	47.0	-1.35	
6	50.5	0.00	
7	52.0	0.58	
8	24.0	-10.21	§
11A	35.5	-5.78	§
11B	52.5	0.77	
14	50.5	0.00	
15	53.0	0.96	
16A	49.0	-0.58	
16B	49.0	-0.58	
16C	50.50	0.00	
17	53.5	1.16	
18	50.5	0.00	
21	49.5	-0.39	
22A	51.0	0.19	
22B	49.5	-0.39	
23	50.5	0.00	
25	55	1.73	
26	50.5	0.00	
28	51.0	0.19	
29	51.5	0.39	
30A	52	0.58	
30B	53	0.96	
31	54.0	1.35	
33	49.5	-0.39	
35	51.0	0.19	
36	49.5	-0.39	
37	51.5	0.39	
38	52.5	0.77	
39	51.5	0.39	
40A	44.5	-2.31	?
40B	47.5	-1.16	
44A	39.5	-4.24	§
44B	36	-5.59	§
45	51.0	0.19	
46	49.0	-0.58	
48	51.5	0.39	
49	50.1	-0.15	
51	50.5	0.00	

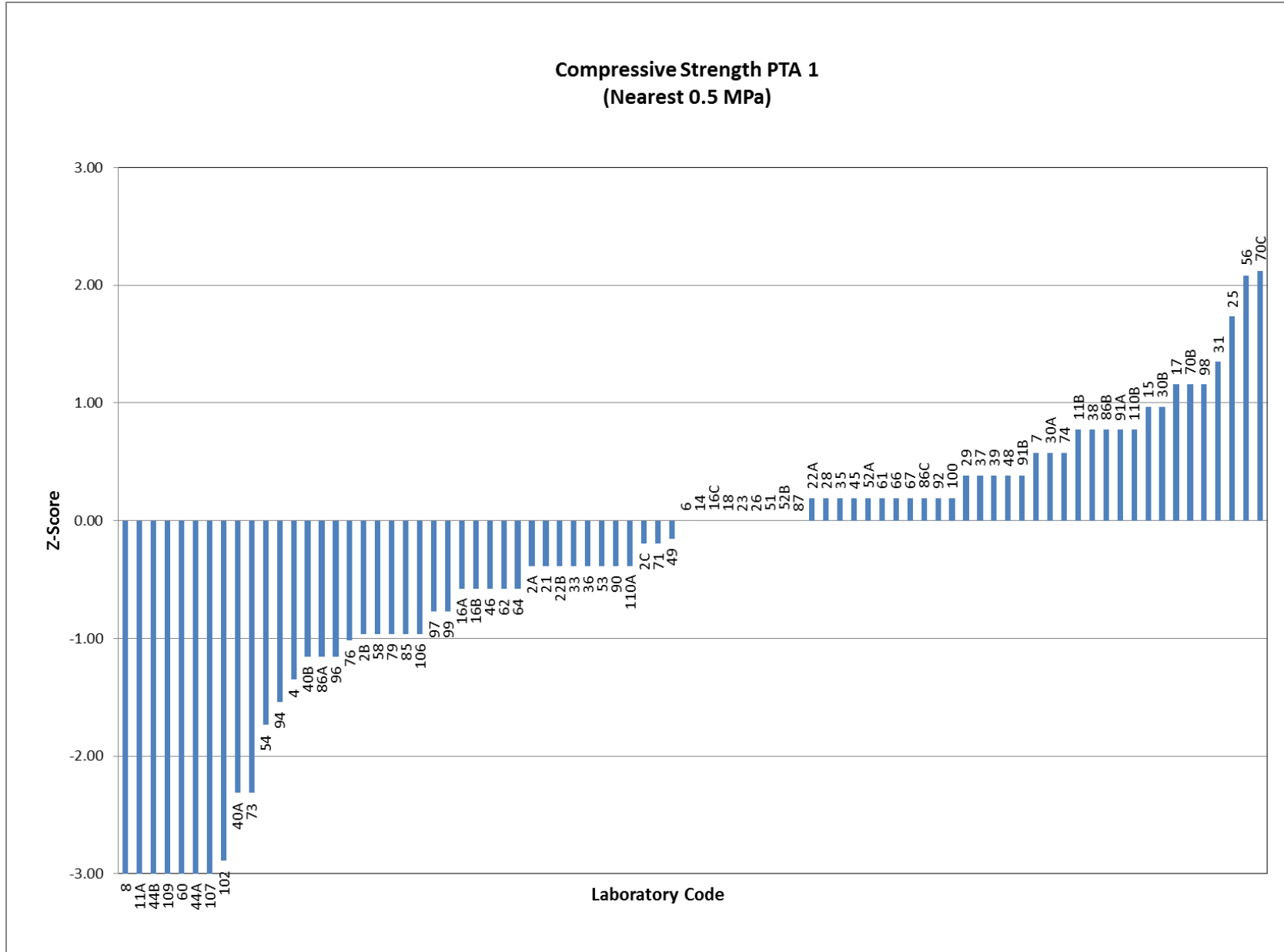
Lab Code	Compressive Strength (Nearest 0.5 MPa)		
	PTA 1	Z-Score	
52A	51.0	0.19	
52B	50.5	0.00	
53	49.5	-0.39	
54	46	-1.73	
56	55.9	2.08	?
58	48	-0.96	
60	39.0	-4.43	§
61	51	0.19	
62	49.0	-0.58	
64	49.0	-0.58	
66	51.0	0.19	
67	51.0	0.19	
70B	53.5	1.16	
70C	56.0	2.12	?
71	50.0	-0.19	
73	44.5	-2.31	?
74	52.0	0.58	
76	47.86	-1.02	
79	48.0	-0.96	
85	48.0	-0.96	
86A	47.5	-1.16	
86B	52.5	0.77	
86C	51.0	0.19	
87	50.5	0.00	
90	49.5	-0.39	
91A	52.5	0.77	
91B	51.5	0.39	
92	51.0	0.19	
94	46.5	-1.54	
96	47.5	-1.16	
97	48.5	-0.77	
98	53.5	1.16	
99	48.5	-0.77	
100	51.0	0.19	
102	43.0	-2.89	?
106	48.0	-0.96	
107	40.5	-3.85	§
109	37.6	-4.97	§
110A	49.5	-0.39	
110B	52.5	0.77	

Compressive Strength PTA 1 (Nearest 0.5 MPa)	
No. of Results	82
Median	50.50
Normalised IQR	2.59
Uncertainty of the Median	0.36
Robust CV	5.1%
Minimum	24
Maximum	56
Range	32

Notes:

"?" indicates an absolute z-score greater than 2.0 but less than 3, i.e. $2.0 < |z\text{-score}| < 3.0$

"§" indicates an outlier, i.e. $|z\text{-score}| \geq 3.0$



Lab Code	Compressive Strength (Nearest 0.5 MPa)		
	PTA 2	Z-Score	
2A	52.0	-0.32	
2B	54.5	0.45	
2C	50.5	-0.79	
4	50.0	-0.94	
6	58.0	1.53	
7	55.0	0.60	
8	22.0	-9.57	§
11A	58.5	1.68	
11B	53.0	-0.02	
14	45.5	-2.33	?
15	53.5	0.14	
16A	56.5	1.06	
16B	52.5	-0.17	
16C	54.00	0.29	
17	57.5	1.37	
18	52.0	-0.32	
21	52.5	-0.17	
22A	52.5	-0.17	
22B	54.5	0.45	
23	51.0	-0.63	
25	62	2.76	?
26	49.5	-1.09	
28	52.5	-0.17	
29	51.5	-0.48	
30A	51.5	-0.48	
30B	54.5	0.45	
31	59.0	1.83	
33	54.0	0.29	
35	54.5	0.45	
36	46.5	-2.02	?
37	49.5	-1.09	
38	53.5	0.14	
39	54.0	0.29	
40A	51.0	-0.63	
40B	50.0	-0.94	
44A	29.0	-7.42	§
44B	35	-5.57	§
45	53.5	0.14	
46	54.5	0.45	
48	49.5	-1.09	
49	52.2	-0.26	

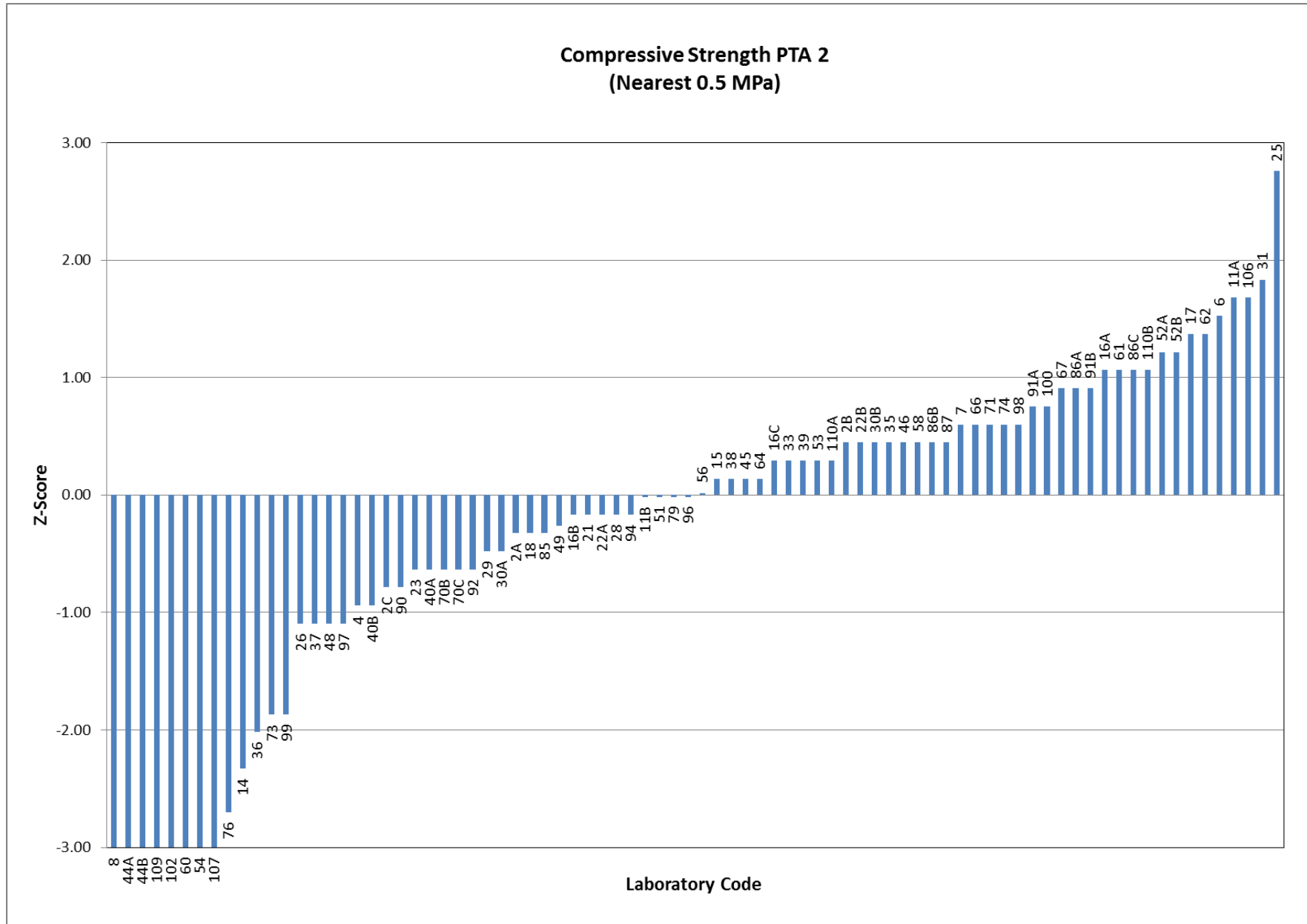
Lab Code	Compressive Strength (Nearest 0.5 MPa)		
	PTA 2	Z-Score	
51	53.0	-0.02	
52A	57.0	1.22	
52B	57.0	1.22	
53	54.0	0.29	
54	40.5	-3.87	§
56	53.1	0.02	
58	54.5	0.45	
60	39.0	-4.33	§
61	56.5	1.06	
62	57.5	1.37	
64	53.5	0.14	
66	55.0	0.60	
67	56.0	0.91	
70B	51.0	-0.63	
70C	51.0	-0.63	
71	55.0	0.60	
73	47.0	-1.87	
74	55.0	0.60	
76	44.29	-2.70	?
79	53.0	-0.02	
85	52.0	-0.32	
86A	56.0	0.91	
86B	54.5	0.45	
86C	56.5	1.06	
87	54.5	0.45	
90	50.5	-0.79	
91A	55.5	0.76	
91B	56.0	0.91	
92	51.0	-0.63	
94	52.5	-0.17	
96	53.0	-0.02	
97	49.5	-1.09	
98	55.0	0.60	
99	47.0	-1.87	
100	55.5	0.76	
102	38.7	-4.42	§
106	58.5	1.68	
107	42.0	-3.41	§
109	36.2	-5.20	§
110A	54.0	0.29	
110B	56.5	1.06	

Compressive Strength PTA 2 (Nearest 0.5 MPa)	
No. of Results	82
Median	53.05
Normalised IQR	3.24
Uncertainty of the Median	0.45
Robust CV	6.1%
Minimum	22
Maximum	62
Range	40

Notes:

"?" indicates an absolute z-score greater than 2.0 but less than 3, i.e. $2.0 < |z\text{-score}| < 3.0$

"§" indicates an outlier, i.e. $|z\text{-score}| \geq 3.0$



Lab Code	Failure Mode		Date of Receipt	Date of Testing
	PTA 1	PTA 2		
2A	N	N	5/12/2018	12/12/2018
2B	N	N	7/12/2018	12/12/2018
2C	C	C	6/12/2018	12/12/2018
4	Type 3	Type 3	4/12/2018	12/12/2018
6	Normal	Normal	11/12/2018	12/12/2018
7	Shear	Shear	7/12/2018	12/12/2018
8	Type 3	Type 3	3/12/2018	12/12/2018
11A	Normal	Normal	5/12/2018	12/12/2018
11B	Vertical Splitting	Vertical Splitting	5/12/2018	12/12/2018
14	N	N	7/12/2018	12/12/2018
15	Compressive	Compressive	5/12/2018	12/12/2018
16A	Shear/Cone	Shear/Cone	6/12/2018	12/12/2018
16B	Diagonal Shear	Diagonal Shear/ Cone	6/12/2018	12/12/2018
16C	Cone	Diagonal Shear	6/12/2018	12/12/2018
17	N	N	5/12/2018	12/12/2018
18	N	N	7/12/2018	12/12/2018
21	Compressive	Compressive	4/12/2018	12/12/2018
22A	Shear Cone	Shear Cone	10/12/2018	13/12/2018
22B	Normal	Normal	13/12/2018	13/12/2018
23	Cap	Cap	17/12/2018	17/12/2018
25	Shear	Cone/Split	7/12/2018	12/12/2018
26	Type 2	Type 2	5/12/2018	12/12/2018
28	N	N	4/12/2018	12/12/2018
29	#	#	5/12/2018	12/12/2018
30A	Conical	Conical	5/12/2018	12/12/2018
30B	Conical	Conical	5/12/2018	12/12/2018
31	Shear	Shear	December	12/12/2018
33	Normal	Normal	7/12/2018	12/12/2018
35	N	N	5/12/2018	12/12/2018
36	Conic	Conic	6/12/2018	12/12/2018
37	Normal	Normal	4/12/2018	12/12/2018
38	D(Shear)	D(Shear)	10/12/2018	12/12/2018
39	Satisfactory	Satisfactory	3/12/2018	12/12/2018
40A	ASTM C309 Type 5	ASTM C309 Type 2	3/12/2018	12/12/2018
40B	ASTM C309 Type 2	ASTM C309 Type 2	3/12/2018	12/12/2018
44A	Columnar	Columnar	10/12/2018	12/12/2018
44B	Columnar	Columnar	10/12/2018	12/12/2018
45	Normal/Cone	Normal/Cone	10/12/2018	12/12/2018
46	Normal	Normal	4/12/2018	12/12/2018
48	Type 2	Type 2	12/12/2018	12/12/2018
49	Normal	Normal	5/12/2018	12/12/2018
51	Normal	Normal	3/12/2018	12/12/2018

Lab Code	Failure Mode		Date of Receipt	Date of Testing
	PTA 1	PTA 2		
52A	Normal	Normal	4/12/2018	12/12/2018
52B	Normal	End	4/12/2018	12/12/2018
53	Tensile Dominated	Tensile Dominated	4/12/2018	12/12/2018
54	Cone	Cone Sheer	4/12/2018	11/12/2018
56	Type 2	Type 2	4/12/2018	12/12/2018
58	Shear	Cone + Shear	#	12/12/2018
60	#	#	3/12/2018	12/12/2018
61	Cone and Shear	Shear	10/12/2018	12/12/2018
62	Normal	Normal	5/12/2018	12/12/2018
64	N	N	4/12/2018	12/12/2018
66	Cone	Shear	5/12/2018	12/12/2018
67	Normal	Normal	4/12/2018	12/12/2018
70B	Shear	Shear	#	12/12/2018
70C	Normal	Shear	#	12/12/2018
71	Shear	Shear	3/12/2018	12/12/2018
73	Normal	Normal	3/12/2018	12/12/2018
74	Cone & Split	Splitting	11/12/2018	12/12/2018
76	Cone & Shear	Cone & Shear	4/12/2018	12/12/2018
79	Normal	Normal	4/12/2018	12/12/2018
85	A	A	6/12/2018	12/12/2018
86A	N	N	5/12/2018	12/12/2018
86B	N	N	5/12/2018	12/12/2018
86C	N	N	5/12/2018	12/12/2018
87	N	N	12/12/2018	12/12/2018
90	Normal	Normal	7/12/2018	12/12/2018
91A	N	N	7/12/2018	12/12/2018
91B	N	N	7/12/2018	12/12/2018
92	Normal	Normal	5/12/2018	12/12/2018
94	Cap Failure	Cap Failure	10/12/2018	12/12/2018
96	Normal	Point Failure	5/12/2018	12/12/2018
97	N	N	12/12/2018	12/12/2018
98	Normal	Normal	5/12/2018	12/12/2018
99	Shear	Shear	3/12/2018	12/12/2018
100	Conic	Conic	5/12/2018	12/12/2018
102	Satisfactory	Satisfactory	28/11/2012	12/12/2018
106	Normal	Normal	5/12/2018	12/12/2018
107	Type 3	Type 3	6/12/2018	12/12/2018
109	Normal	Normal	3/12/2018	12/12/2018
110A	N	N	11/12/2018	13/12/2018
110B	N	N	13/12/2018	13/12/2018

Lab Code	Moisture Condition	End Treatment	Method
2A	SSD	Ground	AS 1012.9
2B	SSD	Ground	AS 1012.9
2C	SSD	Rubber Capped	AS 1012.9
4	SSD	Sulphur Cap	ASTM C-39
6	SSD	Rubber Capping	AS 1012
7	SSD	End Grinding	AS 1012
8	SSD	Uncapped	ASTM (C39/C39M)
11A	SSD	Ground	AS 1012.9
11B	SSD	Ground	AS 1012.9
14	SSD	Sulphur Capped	AS 1012.9, clause 6.2.4(b), 6.2.5.(a)
15	SSD	Sulphur Cap	AS 1012.9
16A	SSD	1 x Rubber Cap per Block	NZS 3112:1986, Part 2, Tests 4 & 6
16B	SSD	1 x Rubber (each)	NZS 3112:1986, Part 2, Tests 4 & 6
16C	SSD	1 Rubber Cap Used	NZS 3112:1986, Part 2, Tests 4 & 6
17	SSD	Ground	AS 1012.9
18	SSD	Sulphur	AS 1012
21	Dry	Rubber Cap	AS 1012
22A	SSD	Rubber Capping	AS 1012
22B	SSD	Rubber Cap	AS 1012.12.1
23	SSD	Rubber Cap	AS 1012.9 & AS 1012.12.1
25	SSD	Rubber Capped	AS 1012.9
26	Dry	Grinding	ASTM C39/C39 M-18
28	SSD	Rubber Cap	AS 1012
29	SSD	Double Ends Ground	AS 112.9 & AS 1012.12.1
30A	SSD	Cylinders Ground Flat	AS 1012.9
30B	SSD	Cylinders Ground Flat	AS 1012.9
31	SSD	Rubber Capping	#
33	SSD	Rubber Cap	AS 1012.9 & AS 1012.12.1
35	SSD	Ground	AS 1012.8.1.24, Method 8.1 for making curing/compression
36	Moist surface	Sulphur Capping	AS 1012.9, AS 1012.12.1
37	SSD	Grinding to Level	AS 1012
38	SSD	Rubber Cap	AS 1012.9
39	SSD	Grinding	BS EN 12390-3
40A	SSD	Rubber Cap (top end of each cylinder as - cast)	NZS 3112 Part 2 (strength) ; NZS 3112 Part 3 (SSD density)
40B	SSD	Rubber Cap (top end of each cylinder as - cast)	NZS 3112 Part 2 (strength) ; NZS 3112 Part 3 (SSD density)
44A	SSD	Rubber Capping	#
44B	SSD	Rubber Capping	#
45	SSD	End Ground	AS 1012.9:2014 Appendix A

Lab Code	Moisture Condition	End Treatment	Method
46	SSD	Sulphur Capped	AS 1012.9
48	Dry	End Grinding	ASTM C98/C39 7-18
49	SSD	Ground Finish	Grinding
51	SSD	Rubber Capping	AS 1012
52A	Moist	Restrained Natural Rubber Capping	AS 1012
52B	Moist	Restrained Natural Rubber Capping	AS 1012
53	SSD	End Capped to 0.02 mm	AS 1012
54	SSD	Rubber Cap	AS 1012
56	SSD	Rubber Capping	ASTM C-39
58	SSD	Rubber Capping	AS 1012
60	Moist surface	Rubber Capping	AS 1012.9, AS 1012.12.1
61	SSD	End Grinding Machine & Rubber Cap	AS 1012 Method 9
62	SSD	Rubber Cap	AS 1012.9
64	SSD	Ground	AS 1012.9
66	SSD	Moulded specimens complied with AS 1012.9 Clause 4.1 then rubber cap was use for testing	AS 1012.9 & AS 1012 12.1
67	SSD	End Ground	AS 1012.9
70B	SSD	End Ground	AS 1012.9
70C	SSD	End Ground	AS 1012.9
71	SSD	No Further Treatment	AS 1012
73	SSD	Sulphur Cap	AS 1012
74	SSD	Rubber	AS 1012.9
76	SSD	Gypsum Capping	ASTM C39/C39M-05
79	SSD	Rubber Cap	AS 1012
85	SSD	Rubber Cap	AS 1012.9
86A	SSD	Rubber Cap	1012.9
86B	SSD	Rubber Cap	1012.9
86C	SSD	Rubber Cap	1012.9
87	SSD	Ground	AS 1012
90	SSD	Rubber Capping	AS 1012.9
91A	SSD	Ground	AS 1012.9
91B	SSD	Ground	AS 1012.9
92	SSD	Sulphur	AS 1012
94	SSD	Rubber Capping	AS 1012.9,12.1
96	SSD	Rubber Cap	1012.9, 1012.12.1
97	SSD	Sulphur Cap	1012.9:2014
98	SSD	Ground	AS 1012
99	SSD	Sulphur Capped	AS 1012.9, AS 1012.12.1
100	SSD	Sulphur Capped Ends	AS 1012.9

Lab Code	Moisture Condition	End Treatment	Method
102	SSD	Sulphur Capping	BS EN 12390-3:2009
106	SSD	Rubber Cap	NZS 3112
107	SSD	Capping as per ASTM C-617:2015	ASTM C39/C39M - 18
109	SSD	Sulphur Capping	AS 1012
110A	SSD	End Ground	AS 1012
110B	SSD	Rubber Cap	AS 1012.9

APPENDIX B

Homogeneity Testing

B1

The samples utilised in this program were supplied by Soil Engineering Services Pty Ltd, Townsville Laboratory. Samples PTA 1 and PTA 2 were cast on two separate days. Ten random samples from each day were selected and tested for homogeneity after three weeks. Statistical analysis showed that the samples were sufficiently homogeneous so that any results identified as outliers could not be attributed to sample variability.

The results of the homogeneity testing, along with summary statistics are provided in the tables below.

PTA 1										
Sample Number	Date Sampled	Date Tested	Height (mm)	Average Diameter (mm)	Weight (g)	Mass per Unit Volume (kg/m ³)	Compressive Strength (Mpa)	Age of Specimen (Days)	Capping Method	Condition of Specimen
17	30/10/2018	21/11/2018	200	100.4	3639	2293	43	22	Rubber	Shear
29	30/10/2018	21/11/2018	199	100.4	3622	2303	43	22	Rubber	Shear
46	30/10/2018	21/11/2018	199	100.4	3628	2298	40	22	Rubber	Shear
51	30/10/2018	21/11/2018	200	100.2	3643	2305	41.5	22	Rubber	Shear
71	30/10/2018	21/11/2018	199	100.4	3617	2300	43.5	22	Rubber	Shear
72	30/10/2018	21/11/2018	198	100	3607	2314	40.5	22	Rubber	Cone
77	30/10/2018	21/11/2018	198	100	3609	2316	42.5	22	Rubber	Shear
86	30/10/2018	21/11/2018	198	100.6	3629	2315	43.5	22	Rubber	Cone
94	30/10/2018	21/11/2018	200	100.6	3652	2301	44	22	Rubber	Shear
100	30/10/2018	21/11/2018	200	100.6	3644	2287	43	22	Rubber	Cone
Mean			199.10	100.36	3629.00	2303.2	42.45			
Standard Deviation			0.88	0.23	15.38	9.61	1.34			
Coefficient of Variation			0.44%	0.23%	0.42%	0.42%	3.16%			
Lowest Value			198	100	3607	2287	40			
Highest Value			200	100.6	3652	2316	44			

PTA 2										
Sample Number	Date Sampled	Date Tested	Height (mm)	Average Diameter (mm)	Weight (g)	Mass per Unit Volume (kg/m ³)	Compressive Strength (Mpa)	Age of Specimen (Days)	Capping Method	Condition of Specimen
17	1/11/2018	22/11/2018	199	100.4	3631	2300	48.5	21	Rubber	Shear
29	1/11/2018	22/11/2018	198	100.4	3637	2315	48	21	Rubber	Shear
46	1/11/2018	22/11/2018	198	100.4	3607	2296	44.5	21	Rubber	Shear
51	1/11/2018	22/11/2018	198	100.6	3617	2293	44.5	21	Rubber	Cone
71	1/11/2018	22/11/2018	199	100.6	3617	2282	45	21	Rubber	Shear
72	1/11/2018	22/11/2018	199	100.6	3655	2306	43.5	21	Rubber	Cone
77	1/11/2018	22/11/2018	198	100.4	3618	2303	45	21	Rubber	Shear
86	1/11/2018	22/11/2018	198	100	3608	2315	49.5	21	Rubber	Cone
94	1/11/2018	22/11/2018	198	100.6	3620	2295	45	21	Rubber	Shear
100	1/11/2018	22/11/2018	199	100.6	3619	2283	46.5	21	Rubber	Cone
Mean			198.40	100.46	3622.90	2298.8	46.00			
Standard Deviation			0.52	0.19	14.48	11.47	2.01			
Coefficient of Variation			0.26%	0.19%	0.40%	0.50%	4.38%			
Lowest Value			198	100	3607	2282	43.5			
Highest Value			199	100.6	3655	2315	49.5			

APPENDIX C

Documentation

Instructions to Participants	C1
Results Sheet	C3

PROFICIENCY TESTING AUSTRALIA
Proficiency Testing Program
Concrete Round 25

INSTRUCTIONS TO PARTICIPANTS

PLEASE NOTE CYLINDERS ARE TO BE TESTED ON THE 12 DECEMBER 2018.

If you receive your cylinders before this date keep them sealed in the plastic bucket (do not place them in the curing tank).

If you receive your cylinders after this date test them as soon as possible.

Please read instructions carefully **BEFORE** commencing testing.

To ensure that the results of this program can be analysed properly, participants are asked to carefully note the following:

1. Two concrete cylinders (nominally 100 mm diameter x 200 mm length) have been supplied to each laboratory. The cylinders are marked PTA 1 and PTA 2.
2. Participants are to treat the proficiency testing samples as they would a routine sample tested in the laboratory.
3. The following determinations are to be performed on each sample:

Height - to nearest 1 mm

Diameter - to nearest 0.2 mm

Weight - to nearest 1g

Mass per unit Volume - to the nearest 1 kg/m³

Maximum Sustained Load Unit - to nearest 1 kN

Compressive Strength - to the nearest 0.5 MPa

Type of Fracture

The results for all determinations are to be recorded on the results sheet to the accuracy and reporting basis indicated where possible. **Please ensure you check your rounding details.**

4. The tests are based on AS1012; however other equivalent methods may be used. Note a higher level of accuracy is requested for specific tests to allow for statistical comparison.
5. Remove the newspaper and plastic bag, and record the moisture condition on the results sheet. Also record if there has been any damage caused to the cylinders.
6. Remove and test the cylinders marked PTA 1 and PTA 2 on **12 December**.
7. Wipe all the excess water and any loose accumulation of grit and lime, such that the cylinders have a clean but damp surface only.
8. Immediately weigh the cylinder on a balance to the nearest 1 gram.

9. Measure the height of the cylinders to the nearest 1 mm. Measure the diameter in the middle of the cylinder to the nearest 0.2 mm (Record as Result 1). Repeat the process measuring from a 90° rotation (Record as Result 2). Do not measure on the mould joint as marked on the cylinder.
10. Treat the ends of each test cylinder by sulphur capping, rubber capping or end grinding.
11. After end treatment allow the sulphur caps to cure for 1 hour prior to testing. Moulded rubber capped and ground cylinders may be tested immediately. Test the cylinders for compressive strength to AS1012 or other methods.

The following steps shall be observed:

- 12.1 Wipe clean the upper and lower platten of the testing machine with a hand broom/a cloth.
 - 12.2 Wipe both ends of the cylinder capping to remove excess water.
 - 12.3 Place the cylinder in the testing machine.
 - 12.4 Set the load pacing control unit at 20 MPa ± 2 MPa (157 kN/minute).
 - 12.5 Start the compression machine and increase the load at the rate described in AS1012 until the cylinder fails. Record the maximum load on the results sheet.
 - 12.6 Record the type of failure.
 - 12.7 Record the type of end treatment.
12. Calculate the Mass per unit Volume to the nearest 1 kg/m³.
 13. Calculate the Compressive Strength to the nearest 0.5 MPa.
 14. For this program your laboratory has been allocated the code number shown on the results sheet. All reference to your laboratory in reports associated with this program will be with this code number, thus ensuring confidentiality of results.
 15. All laboratories must return the results sheet no later than **18 December 2018** to:

Emilia Cincu
Proficiency Testing Australia
Fax: 02 9743 6664
Email: emilia.cincu@pta.asn.au

PROFICIENCY TESTING AUSTRALIA
Concrete 25 - Proficiency Testing Program
Results Sheet

TEST DATE: 12 December 2018
Lab Code:

NOTE: When entering results, please ensure that the measurement recorded corresponds to the cylinder PTA 1 or PTA 2.

TEST (report to)	PTA 1		PTA 2	
Height (nearest 1 mm)				
Diameter (nearest 0.2 mm)				
Weight (nearest 1g)				
Mass/Volume (nearest 1 kg/m ³)				
Maximum Sustained Load Unit (nearest 1 kN)				
Compressive Strength (nearest 0.5 MPa)				
Failure Mode				

Please ensure to check rounding details.

Date of receipt: _____

Moisture condition on receipt (SSD or dry): _____

Details of end treatment: _____

Method: _____

Date of testing: _____

Signature: _____

 Return no later than **18 December 2018** to:

Emilia Cincu
Proficiency Testing Australia
Phone: 02 9736 8397
Fax: 02 9743 6664
Email: emilia.cincu@pta.asn.au

- *End of Report* -