



Report No. 817

Concrete Proficiency Testing

Round 16

August 2013

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 sixteenth round of an ongoing series of programs.

The program was conducted in June 2013 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 Ms L Galbraith and the Technical Advisor was Mr G Hooper. This report was authorised by Dr M Bunt, PTA Statistician.

2. FEATURES OF THE PROGRAM

- (a) Participants were provided with two concrete cylinders labelled PTA 1 and PTA 2.
- (b) A total of 62 laboratories received samples, comprising:
 - 55 Australian participants; and
 - 7 overseas participants, including:
 - New Zealand (1);
 - Bosnia AND Herzegovina (1);
 - Philippines (1);
 - Cyprus (1);
 - Singapore (1); and
 - South Korea (2).

Of these 62 laboratories, 3 were unable to submit 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. 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.

- (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 (for each sample and for each of the analyses performed). Measurement Uncertainty (MU) is also presented where supplied by participants. Please note that this information is presented for information purposes only and has not been used for the formal evaluation of results.
- (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 relevant to each test are presented in Appendix A.
- (h) The document entitled *Guide to Proficiency Testing Australia, 2012* (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 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 7 summarises the outlier results detected.

(b) 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.

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 uncertainty 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).

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: SUMMARY STATISTICS

Test	No. of Results	Median PTA 1	Normalised IQR PTA 1	Median PTA 2	Normalised IQR PTA 2
Height (nearest 1 mm)	59	n/a	n/a	n/a	n/a
Diameter (nearest 0.2 mm)	59	n/a	n/a	n/a	n/a
Weight (nearest 1 gm)	59	n/a	n/a	n/a	n/a
Mass per unit Volume (nearest 1 Kg/m ³)	59	2340.0	11.1	2344.0	15.6
Maximum Sustained Load Unit (nearest 1 kN)	59	n/a	n/a	n/a	n/a
Compressive Strength (nearest 0.1 MPa)	59	37.30	2.19	29.10	1.07

5. PTA AND TECHNICAL ADVISOR'S COMMENTS

Of the 59 laboratories that submitted results for inclusion in the final report ten laboratories received an outlier. There were 12 outliers reported in Round 16 thus, of the 236 results returned for z-score analysis, 5.08% have been identified as outlier results. Any laboratories reporting outliers are encouraged to review their procedures.

TABLE B: COMPARISON OF ROBUST CVs AND PERCENTAGE OF OUTLIERS

Program Name	Sample Number	Mass per unit Volume (nearest 1 Kg/m ³)		Compressive Strength (nearest 0.1 MPa)	
		Robust CV (%)	% outliers	Robust CV (%)	% outliers
Concrete 16	PTA 1	0.5	5.1	5.9	3.4
	PTA 2	0.7	--	3.7	11.9
Concrete 15	PTA 1	0.4	1.8	4.2	7.0
	PTA 2	0.4	3.6	2.8	8.8
Concrete 14	PTA 1	0.6	1.5	3.59	--
	PTA 2	0.6	1.5	3.82	--
Concrete 11	PTA 1	0.4	5.8	3.7	4.4
	PTA 2	0.5	--	3.6	4.4

There is a notable increase in the percentage of outliers for Compressive Strength. Laboratories 10 and 27 may have reported results for the incorrect cylinder. Participants must ensure they pay close attention to labelling as cylinders PTA 1 and PTA 2 are sampled from separate batches of concrete.

Laboratory 2B needs to review their response for Weight as they may have reported the area of the cylinder rather than the weight. For Mass per unit Volume laboratory 12 needs to revisit their calculations as there appears to be an error in either their calculation or recording of results. Laboratories receiving outliers are strongly encouraged to review their procedures.

In addition, some of the results reported are suspected to be rounded numbers that were not required according to the instructions. Rounded results can impact on z-scores and give false outliers. Again, we reinforce the need for participants to read the instructions carefully. It is important that all participants are submitting results to the accuracy level required on the instructions and result sheets, to enable the appropriate evaluation of results for proficiencies.

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 Golder Associates Pty Ltd Standard Operating Procedures to ensure samples were fit-for-purpose and homogeneous.

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 the results tables of Appendix A.

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. Analysis of grouped methods isolates laboratories using method code AS1012.9 for Compressive Strength. The results are tabulated below.

TABLE C: ANALYSIS OF GROUPED METHODS

	Method	No. of Results		Median		Uncertainty of the Median	
		PTA 1	PTA 2	PTA 1	PTA 2	PTA 1	PTA 2
Compressive Strength (nearest 0.1 MPa)	AS1012.9	37	37	37.10	29.00	0.57	0.24

No other methods were so prevalent that they could be analysed as a group.

6. OUTLIER RESULTS

Laboratories reporting outlier results are listed in the following table:

TABLE D: SUMMARY OF STATISTICAL OUTLIERS

Test	Laboratory Code No.
Mass per unit Volume (nearest 1 Kg/m ³)	12, 29, 79
Compressive Strength (nearest 0.1 MPa)	10, 17, 20, 27, 57, 64 and 76

Laboratories with an absolute z-score value between 2.0 and 3.0 (i.e. $2.0 < |z\text{-score}| < 3.0$) are strongly encouraged to review their results. In particular, Laboratories 1, 6 and 73 should examine their procedures and equipment, as these laboratories reported results with absolute z-scores between 2.5 and 3.0.

7. REFERENCE

- [1] *Guide to Proficiency Testing Australia*, 2012 (This document can be found on the PTA website, www.pta.asn.au)

APPENDIX A

Results and Data Analysis

Diameter.....	A1
Height.....	A3
Weight.....	A3
Maximum Sustained Load Unit.....	A3
Mass per unit Volume.....	A5
Compressive Strength.....	A9
Other Information.....	A13

Diameter (nearest 0.2 mm)						
Laboratory code	Sample PTA 1			Sample PTA 2		
	Result 1	Result 2	Average	Result 1	Result 2	Average
1	100.0	100.2	100.1	99.8	100.0	99.9
2A	100.4	100.4	100.4	100.6	100.6	100.6
2B	100.6	100.6	100.6	100.6	100.6	100.6
2C	100.2	100.2	100.2	100.4	100.4	100.4
4	100.8	100.8	100.8	100.2	100.0	100.1
5	100.4	101.0	100.7	100.2	100.7	100.5
6	100.0	100.0	100.0	100.0	100.4	100.2
7	100.0	100.0	100.0	100.2	100.4	100.3
8	99.8	100.0	99.9	99.8	100.0	99.9
9	99.8	99.8	99.8	100.4	100.4	100.4
10	100.0	99.6	99.8	100.2	100.4	100.3
12	100.0	100.0	100.0	100.0	100.0	100.0
13	100.6	100.8	100.7	100.2	100.4	100.3
14	99.8	99.8	99.8	100.0	100.2	100.1
15	100.0	100.6	100.3	99.6	100.2	99.9
16	100.0	100.1	100.1	101.5	99.7	100.6
17	100	100	100.0	100	100	100.0
18	100.0	100.2	100.1	100.0	100.2	100.1
20	99.6	99.8	99.7	99.6	99.80	99.7
21	100.0	100.0	100.0	100.0	100.6	100.3
22	100.0	100.4	100.2	99.8	101.0	100.4
23	100.4	100.4	100.4	99.8	99.8	99.8
24	100.0	100.0	100.0	100.0	100.0	100.0
25	100.6	100.7	100.7	100.1	100.1	100.1
26	100.0	99.5	99.8	100.5	99.2	99.85
27	100.2	100.4	100.3	100.0	100.0	100.0
29	101.8	100.4	101.1	99.7	100.8	100.3
30	100.00	100.00	100.0	100.00	100.00	100.0
31	100.2	100.4	100.3	100.2	100.2	100.2
32A	99.8	99.8	99.8	100.6	100.2	100.4
32B	100.2	100.0	100.1	100.0	99.8	99.9
34	99.8	100.0	99.9	99.6	100.8	100.2
35	100.0	100.2	100.1	100.0	100.4	100.2
37	100.2	100.2	100.2	100.0	100.0	100.0
38	100.0	100.0	100.0	100.0	100.0	100.0
40	99.8	100.2	100.0	99.8	99.8	99.8
41	100.0	101.4	100.7	99.8	99.8	99.8
42A	99.8	100.4	100.1	99.6	99.8	99.7
42B	100.2	100.0	100.1	99.6	100.0	99.8

Diameter (nearest 0.2 mm)						
Laboratory code	PTA 1			PTA 2		
	Result 1	Result 2	Average	Result 1	Result 2	Average
43	100.2	100.2	100.2	99.6	99.8	99.7
44	100.0	100.4	100.2	99.8	99.8	99.8
46	100.0	100.2	100.1	100.0	100.2	100.1
51	100.2	100.6	100.4	100.0	100.2	100.1
52	100.0	100.2	100.1	99.8	100.0	99.9
55	100.8	100.2	100.5	100.0	100.0	100.0
57	99.8	99.8	99.8	100.0	100.1	100.1
59	100.4	100.2	100.3	100.2	100.4	100.3
63	100.0	100.0	100.0	100.8	100.8	100.8
64	99.6	99.6	99.6	100.2	99.8	100.0
65	100.0	100.0	100.0	100.0	100.0	100.0
68	100.0	100.0	100.0	99.8	100.0	99.9
71	100.2	100.2	100.2	99.8	99.8	99.8
72	100.2	100.4	100.3	100.4	100.4	100.4
73	100.0	100.2	100.1	100.2	99.8	100.0
74	100.2	100.2	100.2	100.2	100.2	100.2
76	100.2	100.2	100.2	99.8	99.8	99.8
77	100.0	100.2	100.1	100.0	100.0	100.0
79	100.8	101.2	101.0	101.4	100.0	100.7
80	99.9	99.8	99.9	100.2	99.8	100.0

No of Results:	59	No of Results:	59
Minimum:	99.6	Minimum:	99.7
Maximum:	101.1	Maximum:	100.8
Range:	1.5	Range:	1.1

Laboratory Code	Height (nearest 1 mm)		Weight (nearest 1 gm)		Max. Sustained Load Unit (nearest 1 kN)	
	PTA 1	PTA 2	PTA 1	PTA 2	PTA 1	PTA 2
1	200	200	3674	3647	274	205
2A	198	199	3655	3694	259	228
2B	196	198	7949*	7949*	262	223
2C	198	199	3657	3685	266	220
4	199	200	3697	3679	285	223
5	195.7	195.6	3650	3600	311	244
6	196	196	3640	3660	318	251
7	200	201	3667	3710	306	229
8	199	200	3669	3661	306	231
9	200	200	3652	3702	279	231
10	200	200	3646	3691	237	297
12	200	199	3681	3667	310	233
13	199	200	3673	3677	289	214
14	199	201	3641	3712	304	225
15	195	196	3619	3635	275	211
16	199.5	200.1	3653.5	3718.2	299	231
17	197	199	3636	3664	281	293
18	199	199	3669	3684	281	233
20	199	200	3652	3673	266	270
21	199	199	3663	3679	291	230
22	199	199	3676	3714	288.0	236
23	199	199	3682	3661	298.1	228.3
24	199	200	3664	3700	288	229
25	196	196	3662	3658	300.0	242.9
26	199	199	3660	3660	295	222
27	200	200	3686	3691	189.2	298.2
29	200.0	201	3690	3648	289.2	217.5
30	200	200	3654	3711	296.0	230.2
31	199	201	3666	3704	302	232
32A	197	196	3633	3640	274	214
32B	196	197	3631	3639	279	215
34	201	199	3648	3705	316	228
35	199	199	3668	3682	278	224
37	199	200	3679	3664	298	223
38	200	199	3665	3674	293	232
40	200	198	3662	3699	299	244
41	200	198	3734	3674	294	223
42A	198	198	3694	3656	298	238
42B	200	200	3695	3704	292	234
43	199	198	3664	3621	292	224
44	197	200	3638	3662	309	223
46	197	197	3625	3640	308.0	234.0

Laboratory Code	Height (nearest 1 mm)		Weight (nearest 1 gm)		Max. Sustained Load Unit (nearest 1 kN)	
	PTA 1	PTA 2	PTA 1	PTA 2	PTA 1	PTA 2
51	200	199	3698	3668	295.0	236.6
52	198	199	3675	3684	289	227
55	199	200	3693	3694	307	235
57	199	200	3661	3688	326	275
59	198	198	3666	3691	304	235
63	200	200	3656	3707	282	214
64	199	200	3652	3672	286	189
65	199	201	3658	3711	294	233
68	200	200	3681	3695	275	223
71	200	200	3672	3659	304	222
72	198	199	3660	3687	308	230
73	197	196	3642	3669	314	250
74	199	199	3672	3683	310	230
76	199	201	3680	3668	265	200
77	199	202	3659	3713	294	235
79	200	200	3658	3693	290.6	236.1
80	198.0	200.0	3627	3438	296	222

No of Results:	59	59	58	58	59	59
Minimum:	195	196	3619	3438	189.2	189
Maximum:	201	202	3734	3718	326	298.2
Range:	6	6	115	280	136.8	109.2

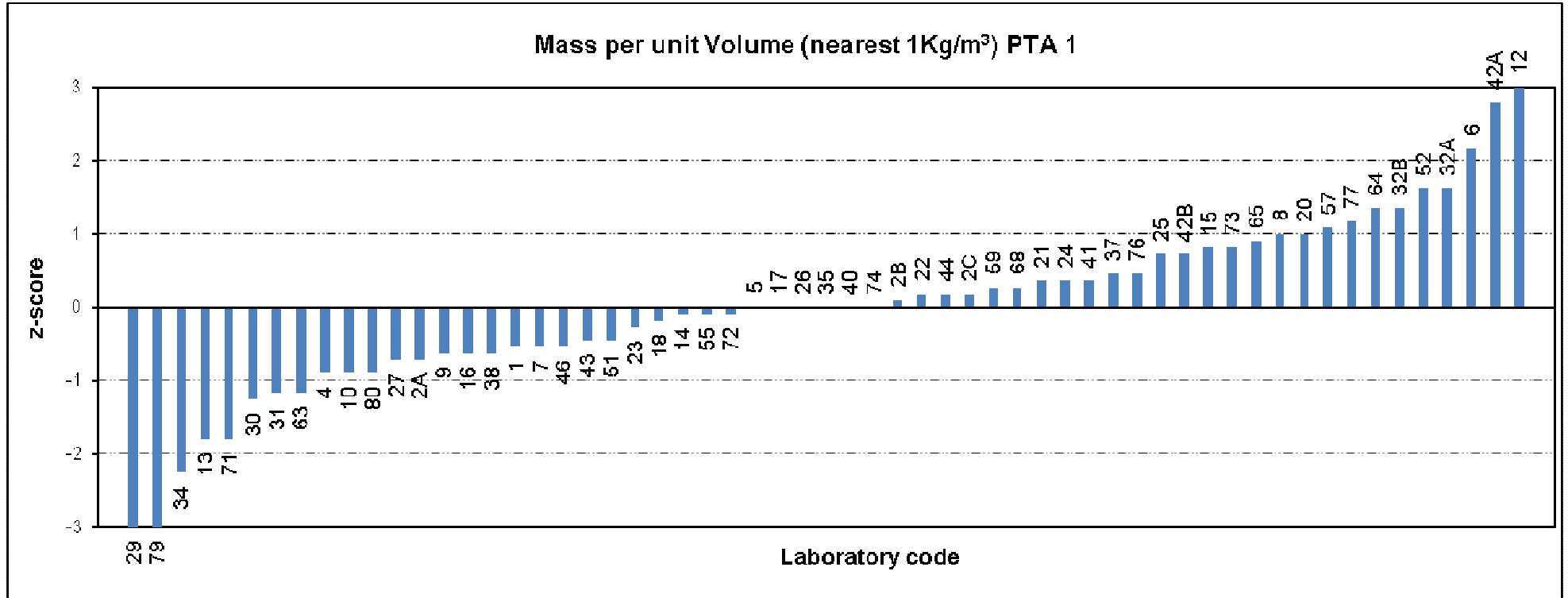
Note: A'' indicates these results were omitted from the consensus to eliminate erroneous results.

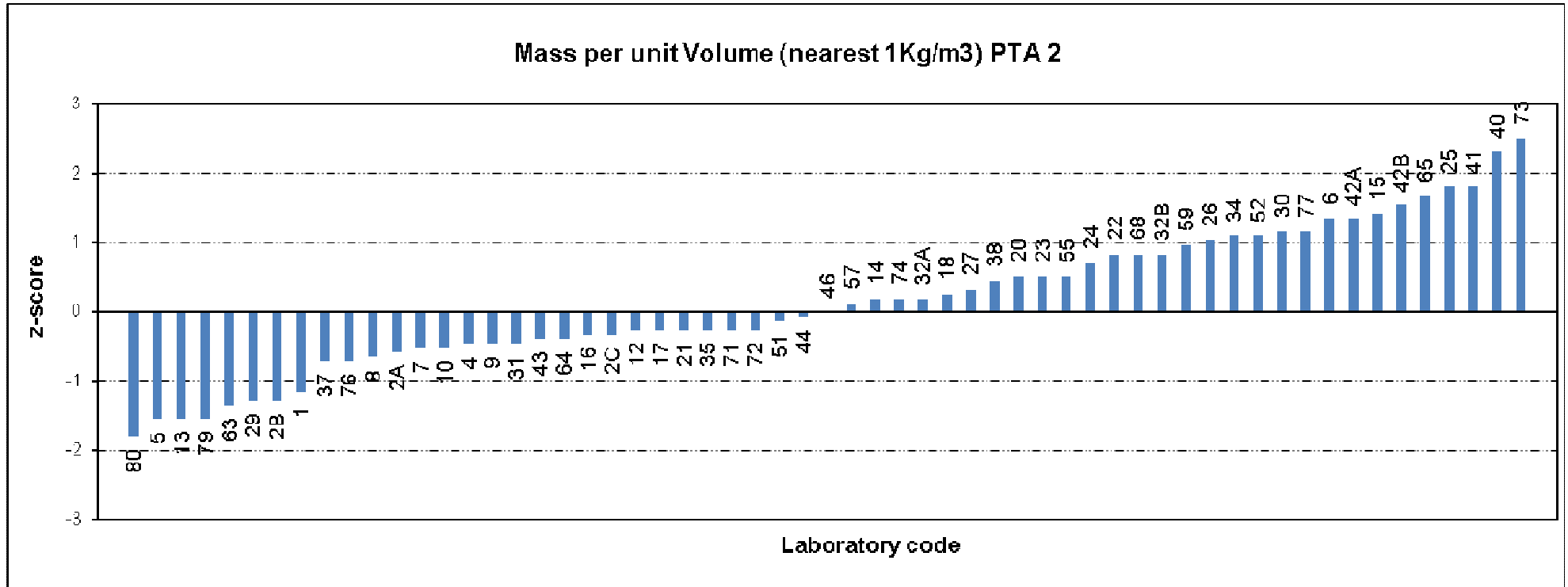
Mass per unit Volume (nearest 1 Kg/m³)				
Laboratory Code	PTA 1	PTA 2	Z-score PTA 1	Z-score PTA 2
1	2334	2326	-0.54	-1.16
2A	2332	2335	-0.72	-0.58
2B	2341	2324	0.09	-1.28
2C	2342	2339	0.18	-0.32
4	2330	2337	-0.90	-0.45
5	2340	2320	0.00	-1.54
6	2364	2365	2.16	1.35
7	2334	2336	-0.54	-0.51
8	2351	2334	0.99	-0.64
9	2333	2337	-0.63	-0.45
10	2330	2336	-0.90	-0.51
12	2458	2340	10.61	§ -0.26
13	2320	2320	-1.80	-1.54
14	2339	2347	-0.09	0.19
15	2349	2366	0.81	1.41
16	2333	2339	-0.63	-0.32
17	2340	2340	0.00	-0.26
18	2338	2348	-0.18	0.26
20	2351	2352	0.99	0.51
21	2344	2340	0.36	-0.26
22	2342	2357	0.18	0.84
23	2337	2352	-0.27	0.51
24	2344	2355	0.36	0.71
25	2348	2372	0.72	1.80
26	2340	2360	0.00	1.03
27	2332	2349	-0.72	0.32
29	2266	2324	-6.65	§ -1.28
30	2326	2362	-1.26	1.16
31	2327	2337	-1.17	-0.45
32A	2358	2347	1.62	0.19
32B	2355	2357	1.35	0.84
34	2315	2361	-2.25	1.09
35	2340	2340	0.00	-0.26
37	2345	2333	0.45	-0.71
38	2333	2351	-0.63	0.45
40	2340	2380	0.00	2.31
41	2344	2372	0.36	1.80
42A	2371	2365	2.79	1.35
42B	2348	2368	0.72	1.54
43	2335	2338	-0.45	-0.39
44	2342	2343	0.18	-0.06
46	2334	2344	-0.54	0.00
51	2335	2342	-0.45	-0.13

Mass per unit Volume (nearest 1 Kg/m ³)				
Laboratory Code	PTA 1	PTA 2	Z-score PTA 1	Z-score PTA 2
52	2358	2361	1.62	1.09
55	2339	2352	-0.09	0.51
57	2352	2346	1.08	0.13
59	2343	2359	0.27	0.96
63	2327	2323	-1.17	-1.35
64	2355	2338	1.35	-0.39
65	2350	2370	0.90	1.67
68	2343	2357	0.27	0.84
71	2320	2340	-1.80	-0.26
72	2339	2340	-0.09	-0.26
73	2349	2383	0.81	2.51
74	2340	2347	0.00	0.19
76	2345	2333	0.45	-0.71
77	2353	2362	1.17	1.16
79	2280	2320	-5.40	-1.54
80	2330	2316	-0.90	-1.80

No of Results:	59	59
Median:	2340.0	2344.0
Uncertainty (median):	1.8	2.5
Normalised IQR:	11.1	15.6
Robust CV:	0.5%	0.7%
Minimum:	2266	2316
Maximum:	2458	2383

Note: A “\$” indicates an outlier i.e. |z-score| ≥3.0.



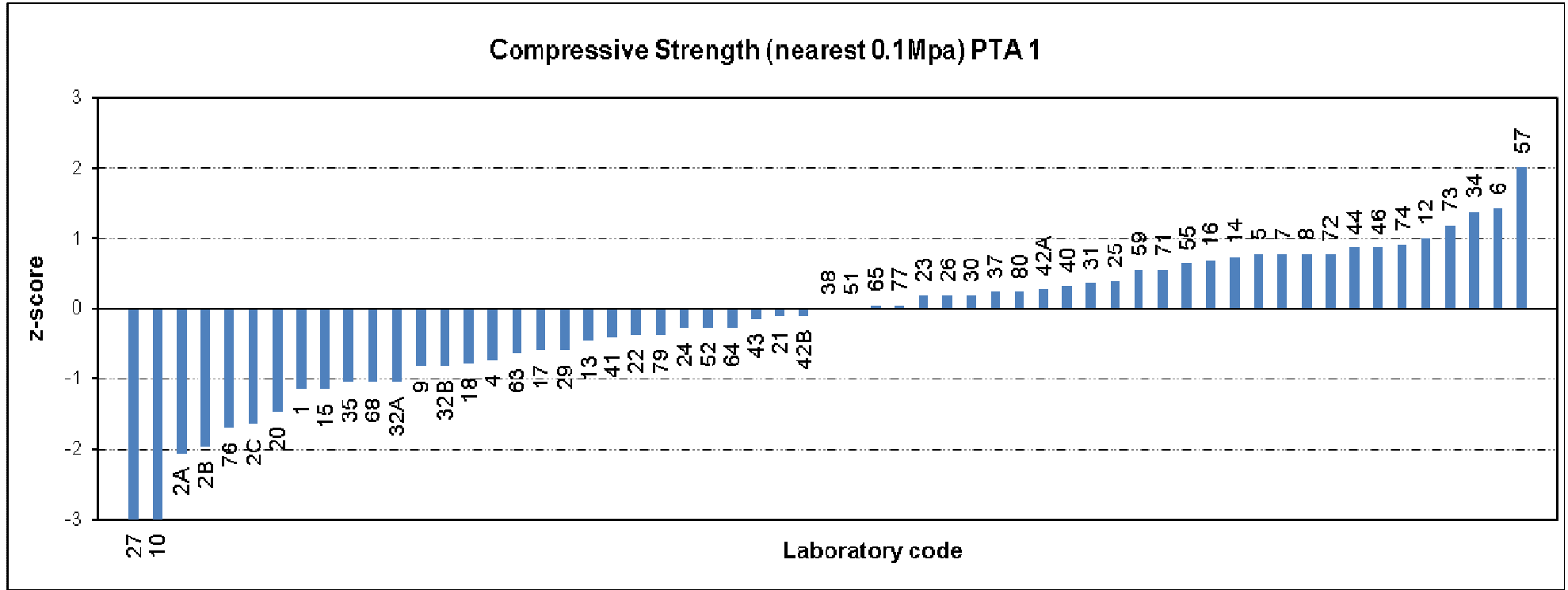


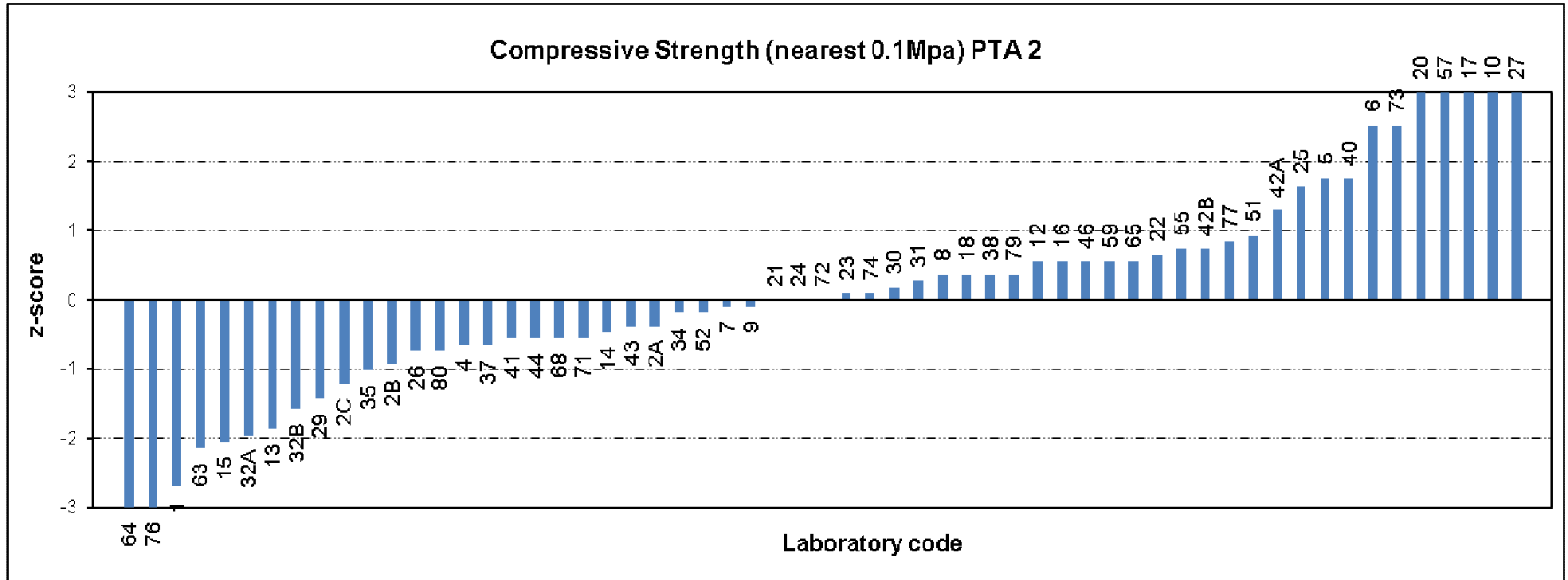
Compressive Strength (nearest 0.1 MPa)				
Laboratory Code	PTA 1	PTA 2	Z-score PTA 1	Z-score PTA 2
1	34.8	26.2	-1.14	-2.70
2A	32.8	28.7	-2.06	-0.37
2B	33.0	28.1	-1.97	-0.93
2C	33.7	27.8	-1.65	-1.21
4	35.7	28.4	-0.73	-0.65
5	39.0	31.0	0.78	1.77
6	40.4	31.8	1.42	2.51
7	39.0	29.0	0.78	-0.09
8	39.0	29.5	0.78	0.37
9	35.5	29.0	-0.82	-0.09
10	30.3	37.6	-3.20	7.91
12	39.5	29.7	1.01	0.56
13	36.3	27.1	-0.46	-1.86
14	38.9	28.6	0.73	-0.47
15	34.8	26.9	-1.14	-2.05
16	38.8	29.7	0.69	0.56
17	36.0	37.5	-0.59	7.81
18	35.6	29.5	-0.78	0.37
20	34.1	34.6	-1.46	5.12
21	37.1	29.1	-0.09	0.00
22	36.5	29.8	-0.37	0.65
23	37.7	29.2	0.18	0.09
24	36.7	29.1	-0.27	0.00
25	38.15	30.87	0.39	1.65
26	37.7	28.3	0.18	-0.74
27	24.0	38.0	-6.08	8.28
29	36.0	27.56	-0.59	-1.43
30	37.7	29.3	0.18	0.19
31	38.1	29.4	0.37	0.28
32A	35.0	27.0	-1.05	-1.95
32B	35.5	27.4	-0.82	-1.58
34	40.3	28.9	1.37	-0.19
35	35.0	28.0	-1.05	-1.02
37	37.8	28.4	0.23	-0.65
38	37.3	29.5	0.00	0.37
40	38.0	31.0	0.32	1.77
41	36.4	28.5	-0.41	-0.56
42A	37.9	30.5	0.27	1.30
42B	37.1	29.9	-0.09	0.74
43	37.0	28.7	-0.14	-0.37
44	39.2	28.5	0.87	-0.56
46	39.2	29.7	0.87	0.56

Compressive Strength (nearest 0.1 MPa)				
Laboratory Code	PTA 1	PTA 2	Z-score PTA 1	Z-score PTA 2
51	37.3	30.1	0.00	0.93
52	36.7	28.9	-0.27	-0.19
55	38.7	29.9	0.64	0.74
57	41.7	35.0	2.01	5.49
59	38.5	29.7	0.55	0.56
63	35.9	26.8	-0.64	-2.14
64	36.7	24.1	-0.27	-4.65
65	37.4	29.7	0.05	0.56
68	35.0	28.5	-1.05	-0.56
71	38.5	28.5	0.55	-0.56
72	39.0	29.1	0.78	0.00
73	39.9	31.8	1.19	2.51
74	39.3	29.2	0.91	0.09
76	33.6	25.6	-1.69	-3.26
77	37.4	30.0	0.05	0.84
79	36.5	29.5	-0.37	0.37
80	37.8	28.3	0.23	-0.74

No of Results:	59	59
Median:	37.30	29.10
Uncertainty (median):	0.36	0.18
Normalised IQR:	2.19	1.07
Robust CV:	5.9%	3.7%
Minimum:	24	24.1
Maximum:	41.7	38

Note: A “§” indicates an outlier i.e. $|z\text{-score}| \geq 3.0$.





Laboratory Code	Failure Mode		Moisture condition on receipt (SSD or dry)	Average temperature of the curing tank (°C)	Details of end treatment	Method
	PTA 1	PTA 2				
1	Compressive	Compressive	SSD	27	Sulphur capping	AS1012.9
4	Normal	Normal	SSD	26	Rubber	AS1012.9
5	Normal	Shear	SSD	29	grinding	1012.9
6	Normal	Normal	SSD		Ground	AS1012 Part 9
7	Normal	Normal	SSD	23.0	Rubber capping	AS1012.9
8	N	N	SSD	27	Rubber cap	1012.9
9	Small fractures	Small fractures	#	22.8	Rubber cap	NZS 3112
10	Normal	Normal	SSD	26	Sulphur cap	AS1012.12.1/AS1012.9
12	Normal	Normal	SSD	27	Rubber cap	AS1012.9
13	Shear	Shear	SSD	22	Rubber cap	AS1012.9
14	Normal	Normal	SSD	22	Rubber cap	AS1012.9 - 6.1b
15	#	#	SSD	#	grinding	AS1012.9 and AS1012.12.1
16	parallel to the direction of load	parallel to the direction of load	cylinders were wet	20	End grinding	JUS U.M1.C20
17	SH	SH	SSD	22.4	Rubber	AS1012.9, AS1012.12
18	Normal fracture	Normal fracture	SSD	26	Water cured under tropical conditions	Rubber capping
20	Cone and shear	Cone and Shear	SSD	22.5	#	Rubber capping
21	N	N	SSD	24	Sulphur capped	AS1012.8.1, AS1012.9
22	C	C	SSD	26.5	Rubber	AS1012
23	Normal	Normal	SSD	24	Rubber cap	AS1012.9 (6.3)
24	Normal	Normal	SSD	22.5	one end ground	AS1012.9
25	Normal	Shear	SSD	23.2	Wet grinding	Wet grinding
26	External cylindrical shear	Longitudinal external shear	SSD	24	Moulded rubber capped	AS1012.3.1, 8.1, 9 and 12.1

Laboratory Code	Failure Mode		Moisture condition on receipt (SSD or dry)	Daily temperature of the curing tank (°C)	Details of end treatment	Method
	PTA 1	PTA 1				
27	Normal	Normal	SSD	#	Rubber capping	AS1012.9
29	Cone and normal	Cone and normal	SSD	23.0	Sulphur capping	AS1012.9
30	Cone (A)	Cone (A)	SSD	23	Rubber cap	AS1012
31	Conical	Conical	SSD	23	Rubber cap	AS1012.9
34	N	N	SSD	23	Sulphur capped	AS1012.9
35	N	N	SSD	23.5	Sulphur	AS1012.8.1, AS1012.9
37	Normal	Normal	SSD	23	End grind	AS1012.9
38	N	N	SSD	24	Rubber capping	AS1012
40	Normal	Normal	SSD	27	Sulphur cap	AS1012.9, .12
41	Normal Compressive fracture	Normal Compressive fracture	SSD	22	Sulphur capped	AS1012.9 - 1999 - Clause 6.2
43	Normal	Normal	SSD	22.5	Ground	AS1012.9, AS1012.12
44	Shear	Shear	SSD	#	PTA 1 - Grind and rubber, PTA 2 - Rubber	AS1141.9, 12
46	Normal	Normal	SSD	26	End grinding	AS1012
51	H (Shear)	N (Normal)	SSD	26	12 June Wet	AS1012.9, AS1012.12.1
52	N	N	SSD	23	Rubber cap	AS1012.8.1, 9, 12.1
55	Normal	Normal	SSD	23	Sulphur	AS1012.9
57	Shear	Shear	SSD	24	Rubber capping	ASTM C39/C39 M-05
59	Conical	Conical	SSD	24	Sulphur	AS1012
63	Satisfactory failure	Satisfactory failure	SSD	19.9	capped	EN 12390-3
64	Spalling	Spalling	SSD	22.3	Sulphur	#
65	Normal/ Cone	Normal/ Cone	SSD	23	Rubber cap	AS1012.9
68	Normal (Cone)	Normal (Cone)	SSD	22	Rubber capping	AS1012.9
71	Standard	Standard	SSD	27	Sulphur capping	Q455B
72	N	N	SSD	23	Sulphur capped	AS1012.9, 6.2.4(b)

Laboratory Code	Failure Mode		Moisture condition on receipt (SSD or dry)	Daily temperature of the curing tank (°C)	Details of end treatment	Method
	PTA 1	PTA 1				
73	Normal	Normal	SSD	28	Grinding - AS1012.9.5 (a)(ii)	AS1012.9 and AS1012.12.1
74	Shear	Shear	SSD	22	Rubber cap	AS1012.9
76	S	N	SSD	23.5	Sulphur cap	AS1012.9
77	Cone	Cone	SSD	24	capped	Sulphur
79	Hair line cracks	Hair line cracks	Std	#	Sulphur capping	AS1012.8.1-2000
80	Conical	Conical	SSD	23	Rubber cap	AS1012.9, 12.1, 12.2
2A	Vertical Splitting	Vertical Splitting	SSD	23.8	Ground	AS1012.9
2B	Vertical Splitting	Vertical Splitting	SSD	23.8	Ground	AS1012.9
2C	Vertical Splitting	Vertical Splitting	SSD	23.8	Ground	AS1012.9
32A	Cone	Cone	SSD	20	Ground cylinders	KS F 2405
32B	Cone	Cone	SSD	20	Ground cylinders	KS F 2405
42A	Normal	Normal	SSD	27.5	Rubber cap	AS1012.9
42B	Normal	Normal	SSD	27.5	Rubber cap	AS1012.9

Note: A '#' indicates no response provided.

APPENDIX B

Homogeneity Testing

Homogeneity Testing

Concrete Round 16 - Proficiency Testing Homogeneity Results										
							Date Compiled:	12/06/13		
		PTA 1							PTA 2	
Date Sampled	Date Tested	MPUV (Kg/m ³)	Compressive Strength (MPa)	Sample Number	Date Sampled	Date Tested	MPUV(Kg/m ³)	Compressive Strength (MPa)		
23/04/2013	12/06/2013	2349	37.2	C1330843	1/05/2013	12/06/2013	2345	29.3		
		2345	36.5	C1330844			2342	30.0		
		2343	36.4	C1330845			2356	30.2		
		2334	36.8	C1330846			2353	29.8		
		2336	36.5	C1330847			2353	29.8		
		2340	37.7	C1330848			2366	29.2		
		2342	37.7	C1330849			2362	30.4		
		2341	37.7	C1330850			2349	29.3		
		2349	36.9	C1330851			2336	29.1		
		2341	37.0	C1330852			2336	29.8		
Mean		2342	37.0	Mean		2350	29.7			
Standard Deviation		4.88	0.52	Standard Deviation		10.20	0.45			
Coefficient of Variation (%)		0.21	1.40	Coefficient of Variation (%)		0.43	1.50			
Lowest Value		2334	36.4	Lowest Value		2336	29.1			
Highest Value		2349	37.7	Highest Value		2366	30.4			

APPENDIX C

Documentation

Instructions to Participants	C1
Results Sheet	C3



PROFICIENCY TESTING AUSTRALIA
Proficiency Testing Program Concrete Round 16

INSTRUCTIONS TO PARTICIPANTS

PLEASE NOTE CYLINDERS ARE TO BE TESTED ON THE 12TH JUNE 2013.

If you receive your cylinders before this date place them in the curing tank and refer to step 5 and 6 of the instructions.

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. Please treat the samples as normal samples received into 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 0.1 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.

4. The tests are based on AS1012; however other 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. Place the cylinders in the curing tank within 30 minutes of unwrapping. Ensure that the cylinders remain totally immersed in water until compression tested. Each day record on the results sheet the temperature (°C) of the curing tank water until tested.
7. Remove and test the cylinders marked PTA 1 and PTA 2 on **12 June 2013**.
8. Wipe all the excess water and any loose accumulation of grit and lime, such that the cylinders have a clean but damp surface only.
9. Immediately weigh the cylinder on a balance to the nearest 1 gram.

10. 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.
11. Treat the ends of each test cylinder by sulphur capping, rubber capping or end grinding.
12. 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.

13. Calculate the Mass per unit Volume to the nearest 1 kg/m³.

14. Calculate the Compressive Strength to the nearest 0.1 MPa.

15. 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.

16. All laboratories must return the results sheet no later than **17 June 2013** to:

Laura Galbraith
Proficiency Testing Australia
Fax: 02 9743 6664
Email: laura.galbraith@pta.asn.au

PROFICIENCY TESTING AUSTRALIA
Concrete 16 - Proficiency Testing Program
Results Sheet

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)	Result 1	Result 2	Result 1	Result 2
Weight (nearest 1g)				
Mass/Volume (nearest 1 kg/m ³)				
Maximum Sustained Load Unit (nearest 1 kN)				
Compressive Strength (nearest 0.1 MPa)				
Failure Mode				

Date of receipt _____

Moisture condition on receipt (SSD or dry): _____

Average temperature of the curing tank:

Details of end treatment _____

Method: _____

Date of tests - PTA 1 & PTA 2: _____

Signature: _____

Return no later than **12 June 2013** to:**Laura Galbraith****Proficiency Testing Australia****Phone: 02 9736 8397****Fax: 02 9743 6664****Email: laura.galbraith@pta.asn.au**

- *End of Report* -