

Report No.1190

Paint Proficiency Testing Program

Round 30

May 2020

ACKNOWLEDGMENTS

PTA wishes to gratefully acknowledge the technical assistance and the samples supply for this program by Mr John Skangos, Wagon Paints Australia Pty Ltd.

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1. FOREWORD

This report summarises the results of a proficiency testing program on a series of paint tests. It constitutes the Round 30 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 March 2020 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 M Li. The Technical Adviser was Mr John Skangos, Wagon Paints Australia Pty Ltd. This report was authorised by Mrs K Cividin, PTA Quality Manager.

2. FEATURES OF THE PROGRAM

- (a) A total of twenty-two laboratories from Australia and Kuwait received samples, with twenty-one participants returning results. Each participant was supplied with one 500ml tin of paint.

Laboratories were asked to perform the following consistency analyses:

- (i) AS 1580.202.1 - density
 - (ii) AS 1580.214.2 - consistency - flow cup
 - (iii) AS 1580.505.1 - pH of Water-based paints
 - (iv) AS 1580.602.2 - measurement of specular gloss
- (b) Prior to distribution, randomly selected samples were tested for homogeneity. Based on the results of this testing, it was concluded that the samples were sufficiently homogeneous, and therefore, any results later identified as outliers could not be attributed to any significant sample variability (See Appendix B).
- (c) Participating laboratories were requested to perform their tests according to the *Instructions to Participants* and to record their results on the *Results Sheets*. They were distributed to participants with the samples (Appendix C).
- (d) Each laboratory was randomly allocated a unique code number for the program to enable confidentiality of results. Reference to each laboratory in this report is made by its code number.
- (e) 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.

- (f) 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.
- (g) The document entitled *Guide to Proficiency Testing Australia, 2019* (reference [1]) defines the statistical terms and details the statistical procedures referred to in this report.
- (h) A tabulated listing of laboratories (by code number) identified as having outlier results can be found on page 4.

3. FORMAT OF THE APPENDICES

- (a) Appendix A contains the analysis of results reported by laboratories for the sample. 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;

Please note that z-scores have been calculated on the average results.

- (b) Appendix B contains details of the homogeneity and stability 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 4 summarises the outlier results detected.

(b) Results Tables and Summary Statistics

Each of these tables contains the results returned by each laboratory, including the method used, and the robust z-score calculated for each result.

For the purpose of consistency in reporting, the results have been rounded to two decimal places for Density (kg/L) and Measurement of Specular Gloss (60°); and to one decimal place for Consistency-Flow Cup (s) and pH of Water-based Paints.

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; 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:

$$\sqrt{\frac{\pi}{2}} \times \frac{\text{normIQR}}{\sqrt{n}} \quad n = \text{number of results}$$

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

5. SUMMARY OF RESULTS AND OUTLIER RESULTS

The following table summarises the results submitted by participants for the program. In order to achieve the program's aim of assessing laboratories' testing performance, a robust statistical approach, which uses z-scores has been utilised. The z-score is a measure of how far the result(s) is from the consensus value - a normalised value which gives a "score" to each result relative to the other results in the group. Therefore a z-score close to zero means that the result agrees well with those from other laboratories. An outlier will be any result(s) which has an absolute z-score value greater than or equal to 3.0.

TABLE A: SUMMARY OF RESULTS

Analyses	Median	Robust CV	No. of Results
Consistency - Flow Cup (s)	68.50	10.8%	14
pH of Water-Based Paints	8.70	3.4%	19
Density (kg/L)	1.020	0.6%	23
Measurement of Specular Gloss (60°)	92.400	2.5%	17

TABLE B: OUTLIER RESULTS

Analyses	Outlier Results (Laboratory Codes)
Consistency - Flow Cup (s)	nil
pH of Water-Based Paints	2A
Density (kg/L)	1, 8*, 13, 17
Measurement of Specular Gloss (60°)	6, 18

"*" Result not included in the statistical analysis as it was considered a blunder

6. PTA AND TECHNICAL ADVISER'S COMMENTS

Metrological Traceability and Measurement Uncertainty of Assigned Values

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

Analysis of Results by Method Groups

All participants were required to use the AS 1580 *Paints and related materials - Methods of Test* series, therefore, results were pooled for analysis.

Comments

Seven laboratories reported outliers (laboratory codes 1, 2A, 6, 8, 13, 17 and 18). These participants should investigate the cause of the outliers, such as interferences from the matrix, instrument conditions, transcription and calculation errors, sample preparation errors and human errors. On the whole, the study should provide valuable information to the participants on the performance of the methods and equipment used.

Measurement of Specular Gloss: Laboratory codes 6 and 8 reported one outlier each for the measurement of specular gloss (60°).

pH of Water-based Paints: Laboratory code 2A reported an outlier.

Consistency - Flow Cup: no outliers were reported for this testing.

Density: the results were all grouped tightly around the median. Laboratory codes 1, 13 and 17 each reported one statistical outlier. Laboratory Code 8 reported a result which was considered a blunder and therefore removed from the statistical evaluation. It is still identified as an outlier.

Considering that the samples were sufficiently homogeneous, all laboratories reporting outlier results should conduct an investigation to determine the cause of these results.

The overall performance was as expected given that the test methods are quite common for most paint laboratories, in particular density, gloss and pH.

Variation in laboratories is of concern for two of the test methods evaluated in this round, namely Consistency-Flow Cup & Measurement of Specular Gloss (60°).

The large variation in the range of results for Consistency-Flow cup may be due to how the end part is determined for this test method. Laboratories are encouraged to review their calibration records and standard oils used.

The range of results for Measurement of Specular Gloss (60°) is high given the expectation of the reproducibility for the geometry selected. Laboratories with outliers are encouraged to review this test method and their calibration records.

For the remaining two test methods, density and pH, the results are within an acceptable range given the practical nature of these test methods.

The source of outlier results may be due to instrument conditions, transcription and calculation errors, sample preparation errors and possible human error.

In conclusion, the results should prove valuable to the laboratories that participated.

7. REFERENCES

[1] *Guide to Proficiency Testing Australia, 2019.*

This document can be found on the PTA website at www.pta.asn.au

[2] AS 1580.202.1 - 1995 *Density*

[3] AS 1580.214.2 - 1996 *Consistency - flow cup*

[4] AS 1580.505.1 - 1996 *pH of Water-based paints*

[5] AS 1580.602.2 - 1995 *Measurement of specular gloss.*

APPENDIX A

Results and Data Analysis

Consistency - Flow Cup	A1
pH of Water-Based Paints	A3
Density	A5
Measurement of Specular Gloss (60°)	A7

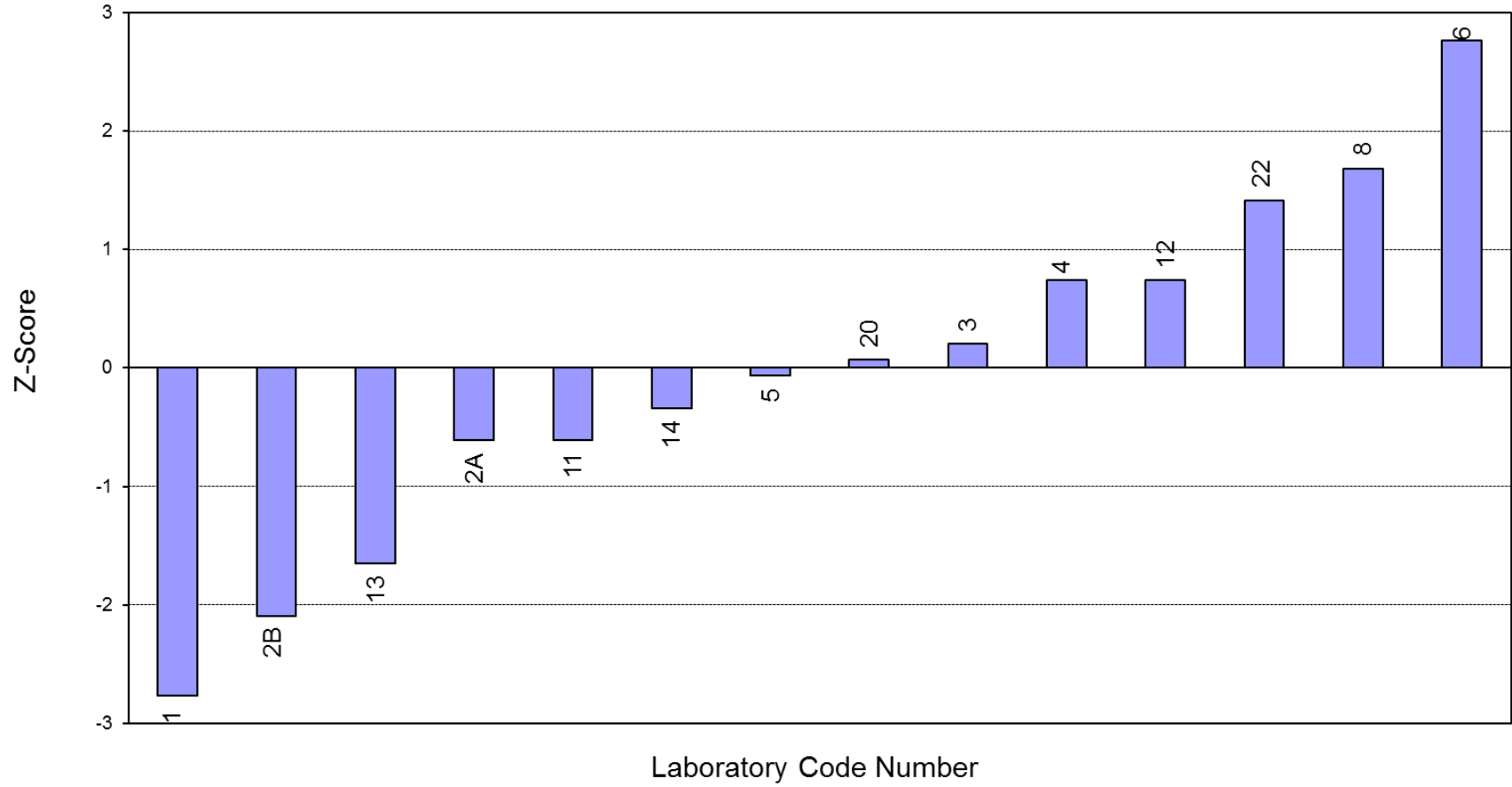
Consistency - Flow Cup - AS/NZS 1580.214.2

Results by Laboratory Code

Lab Code	Results (s)	Robust Z-score
1	48.0	-2.77
2A	64.0	-0.61
2B	53.0	-2.09
3	70.0	0.20
4	74.0	0.74
5	68.0	-0.07
6	89.0	2.77
8	81.0	1.69
11	64.0	-0.61
12	74.0	0.74
13	56.3	-1.65
14	66.0	-0.34
20	69.0	0.07
22	79.0	1.42
<i>No of Results:</i>		14
<i>Median:</i>		68.50
<i>Normalised IQR:</i>		7.41
<i>Robust CV:</i>		10.8%
<i>Minimum:</i>		48.0
<i>Maximum:</i>		89.0
<i>Range:</i>		41.0
<i>Uncertainty (Median)</i>		2.48

For the purpose of consistency in reporting, the above results have been rounded to one decimal place for Consistency-Flow Cup (s).

Consistency - Flow Cup - AS/NZS 1580.214.2



pH of Water-Based Paints - AS/NZS1580.505.1

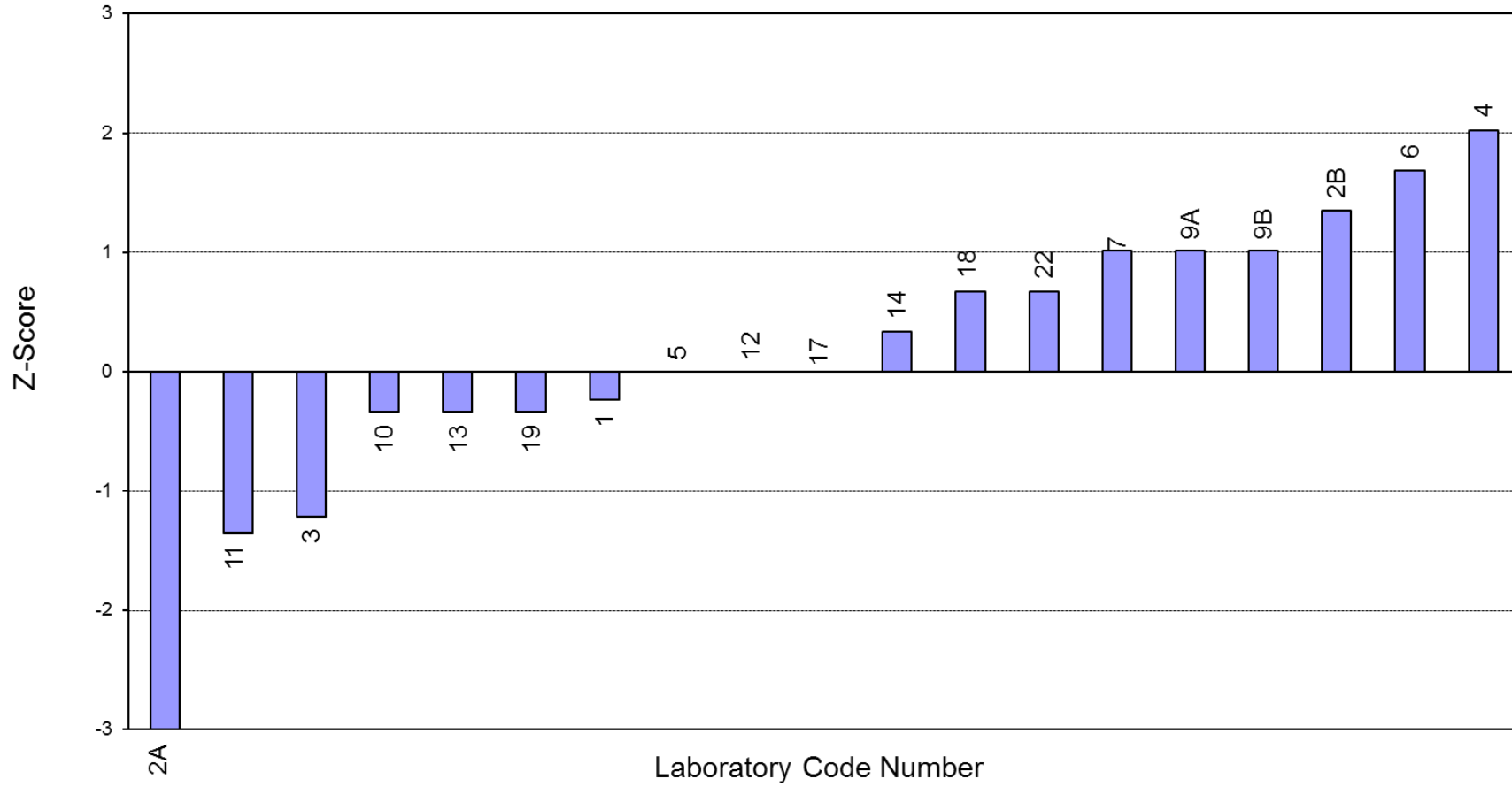
Results by Laboratory Code

Lab Code	Results (0.1 pH unit)	Robust Z-score
1	8.6	-0.24
2A	7.1	-5.40 §
2B	9.1	1.35
3	8.3	-1.21
4	9.3	2.02
5	8.7	0.00
6	9.2	1.69
7	9.0	1.01
9A	9.0	1.01
9B	9.0	1.01
10	8.6	-0.34
11	8.3	-1.35
12	8.7	0.00
13	8.6	-0.34
14	8.8	0.34
17	8.7	0.00
18	8.9	0.67
19	8.6	-0.34
22	8.9	0.67
<i>No of Results:</i>	19	
<i>Median:</i>	8.70	
<i>Normalised IQR:</i>	0.30	
<i>Robust CV:</i>	3.4%	
<i>Minimum:</i>	7.1	
<i>Maximum:</i>	9.3	
<i>Range:</i>	2.2	
<i>Uncertainty (Median)</i>	0.09	

NOTE: "§" denotes an outlier (i.e. those results for which $|z\text{-score}| \geq 3$).

For the purpose of consistency in reporting, the above results have been rounded to one decimal place for pH of Water-based Paints.

pH of Water-Based Paints - AS/NZS1580.505.1



Density - AS/NZS1580.202.1**Results by Laboratory Code**

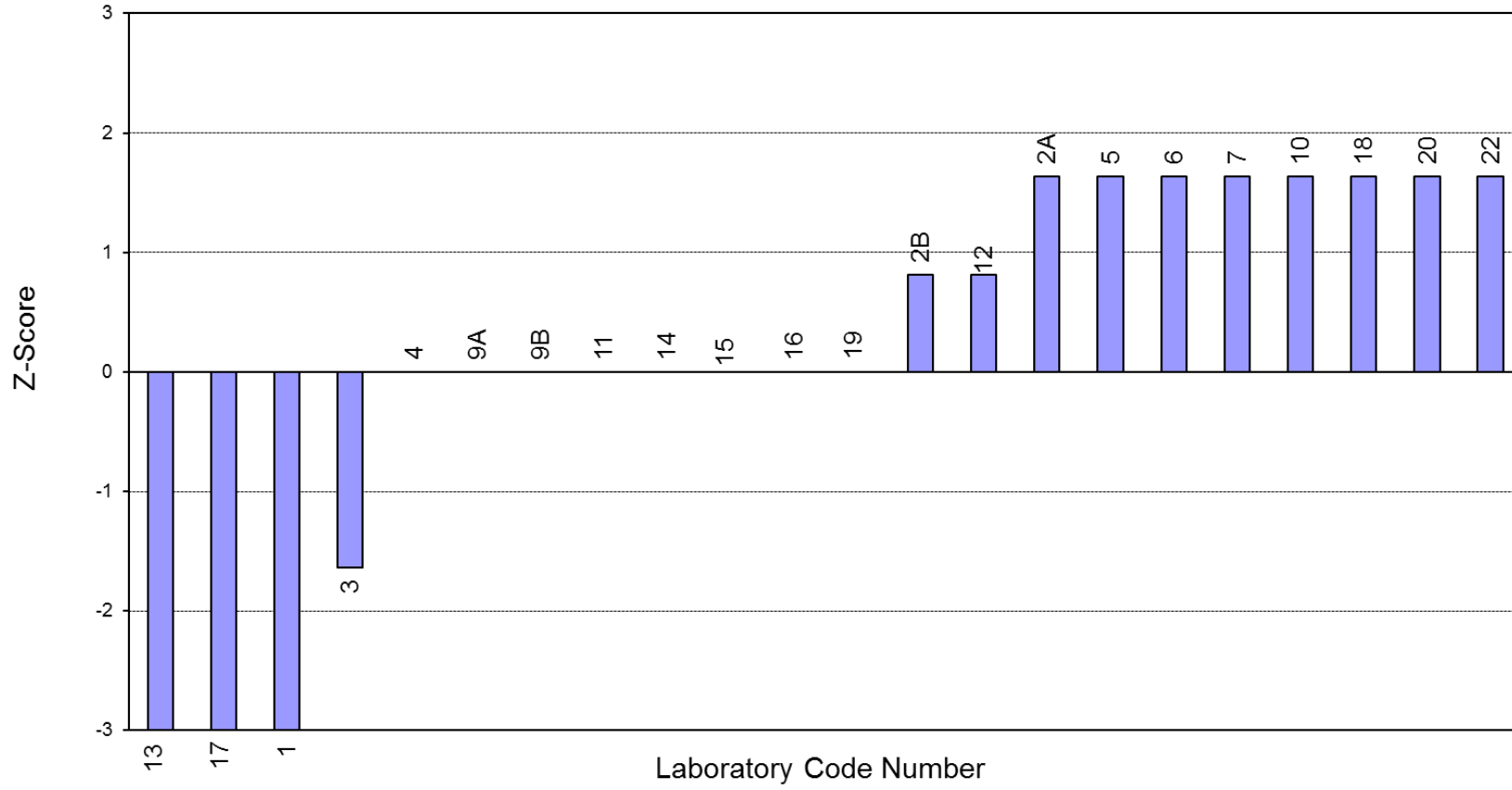
Lab Code	Results (kg/L)	Robust Z-score
1	1.00	-3.10 §
2A	1.03	1.63
2B	1.03	0.82
3	1.01	-1.63
4	1.02	0.00
5	1.03	1.63
6	1.03	1.63
7	1.03	1.63
8 *	102.37	§
9A	1.02	0.00
9B	1.02	0.00
10	1.03	1.63
11	1.02	0.00
12	1.03	0.82
13	0.93	-14.71 §
14	1.02	0.00
15	1.02	0.00
16	1.02	0.00
17	0.98	-6.54 §
18	1.03	1.63
19	1.02	0.00
20	1.03	1.63
22	1.03	1.63
<i>No of Results:</i>	23	
<i>Median:</i>	1.020	
<i>Normalised IQR:</i>	0.006	
<i>Robust CV²:</i>	0.6%	
<i>Minimum:</i>	0.93	
<i>Maximum:</i>	1.03	
<i>Range:</i>	0.10	
<i>Uncertainty (Median)</i>	0.002	

NOTE: "§" denotes an outlier (i.e. those results for which $|z\text{-score}| \geq 3.0$).

"*" Result for Laboratory Code 8 was considered a blunder and not included in the statistical analysis. It is still identified as an outlier.

For the purpose of consistency in reporting, the above results have been rounded to two decimal places for Density (kg/L).

Density - AS/NZS1580.202.1



Measurement of Specular Gloss (60°) - AS 1580.602.2

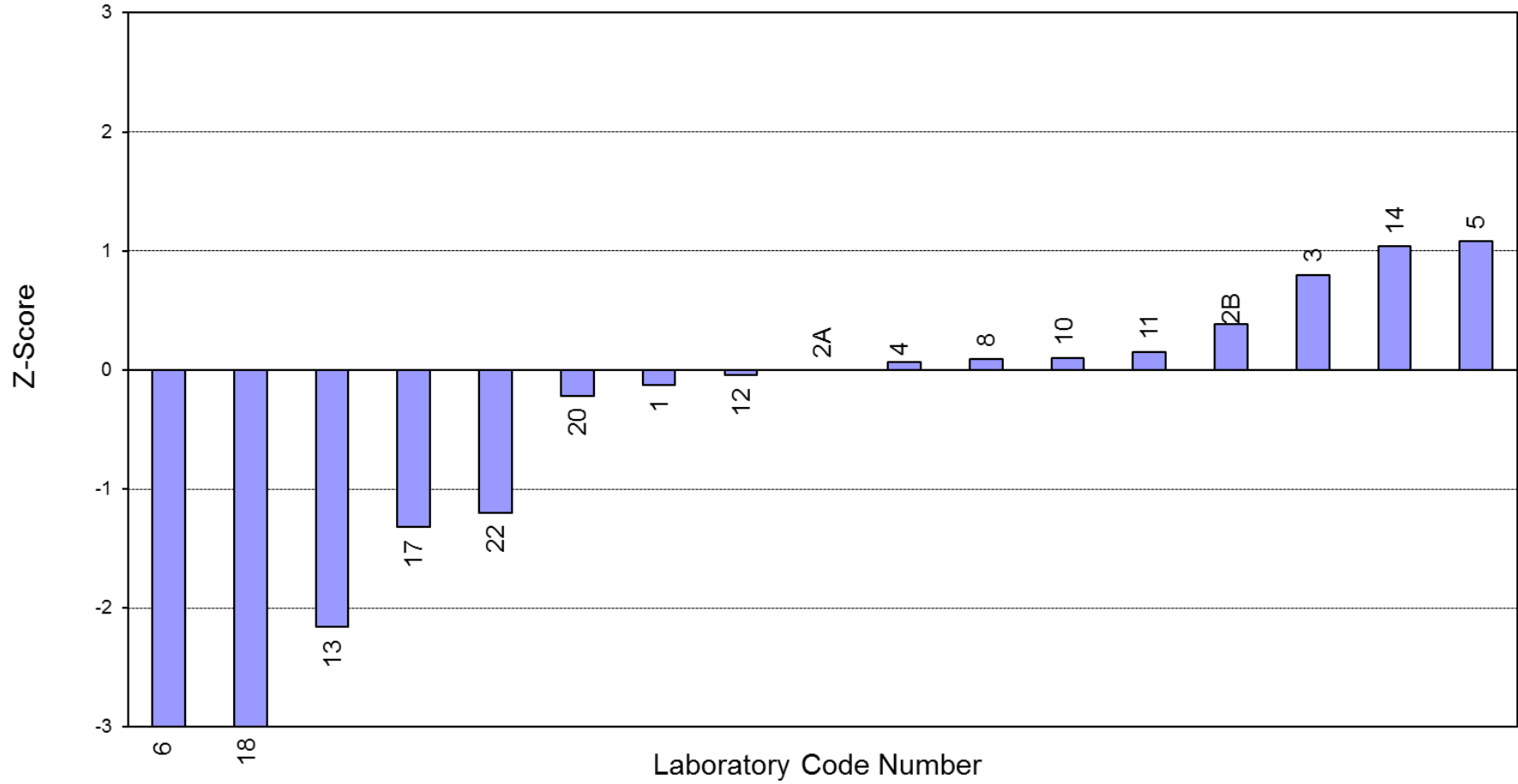
Results by Laboratory Code

Lab Code	Results	Robust Z-score
1	92.10	-0.13
2A	92.40	0.00
2B	93.30	0.39
3	94.25	0.80
4	92.55	0.06
5	94.90	1.08
6	70.60	-9.43 §
8	92.61	0.09
10	92.63	0.10
11	92.75	0.15
12	92.30	-0.04
13	87.40	-2.16
14	94.80	1.04
17	89.35	-1.32
18	79.10	-5.75 §
20	91.90	-0.22
22	89.63	-1.20
<i>No of Results:</i>	17	
<i>Median:</i>	92.400	
<i>Normalised IQR:</i>	2.313	
<i>Robust CV:</i>	2.5%	
<i>Minimum:</i>	70.60	
<i>Maximum:</i>	94.90	
<i>Range:</i>	24.30	
<i>Uncertainty (Median)</i>	0.703	

NOTE: "§" denote outliers (i.e. those results for which $|z\text{-score}| \geq 3.0$).

For the purpose of consistency in reporting, the above results have been rounded to two decimal places for Measurement of Specular Gloss (60°).

Measurement of Specular Gloss (60°) - AS 1580.602.2



APPENDIX B

Sample Homogeneity

HOMOGENEITY TESTING

The samples utilised in this program were supplied by the Wagon Paints Australia Pty Ltd. Each participant was provided with one sample.

For this program, 8 samples were randomly selected and tested for homogeneity. Statistical analysis showed that the samples were sufficiently homogeneous so that any results identified as outliers could not be attributed to sample variability.

Test	Density	
<i>Sample 1</i>	1.01	1.01
<i>Sample 2</i>	1.01	1.01
<i>Sample 3</i>	1.01	1.01
<i>Sample 4</i>	1.01	1.02
<i>Sample 5</i>	1.01	1.01
<i>Sample 6</i>	1.02	1.02
<i>Sample 7</i>	1.01	1.01
<i>Sample 8</i>	1.01	1.01
<i>Median</i>	1.010	1.010
<i>Norm IQR</i>	0.000	0.002
<i>Robust CV</i>	0.00%	0.18%

Table C: Homogeneity Testing Results

APPENDIX C

Documentation

Instructions to Participants

C1

Results Sheet

C3

PROFICIENCY TESTING AUSTRALIA**Paint Proficiency Testing Program Round 30****INSTRUCTIONS TO PARTICIPANTS**

Please read the following carefully **BEFORE** commencing testing.

Each participant will be supplied with one 500ml tin of paint.

To ensure the appropriate analysis of results, participants are asked to adhere carefully to the following instructions:

- 1) The following tests are to be performed on sample as per the Results Sheet:
 - (i) AS 1580.202.1 - density
 - (ii) AS 1580.214.2 - consistency - flow cup
 - (iii) AS 1580.505.1 - pH of Water-based paints
 - (iv) AS 1580.602.2 - measurement of specular gloss
- 2) Determinations on sample are to be conducted in accordance with the appropriate method (stated on the Results Sheet). All laboratories are also encouraged to attempt those tests not included as part of their routine methods.
- 3) The following specific instructions will apply:
 - a. Report the nominal volume of the pycnometer used for AS1580.202.1.
 - b. Report make and model of pH meter used.
 - c. AS1580.602.2 Measurement of specular gloss - readings shall be taken with 60° angle of incidence as per 10.2.
- 4) For this program your laboratory has been allocated the following code number: **«Code»** . This is to allow for the confidential treatment of your results in the final report.
- 5) Testing may commence as soon as samples are received. Please return results,

NO LATER THAN 20 MARCH 2020:

Dr Michael LI Proficiency Testing Australia PO Box 7507 Silverwater NSW 2128 Email: michael.li@pta.asn.au TEL: (02) 9736 8397 FAX: (02) 9743 6664
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PROFICIENCY TESTING AUSTRALIA

Paint Proficiency Testing Program Round 30

Results Sheet

Lab «Code»

Test	AS 1580	Results
Density (report in kg/L to 2 decimal places)	202.1	
Consistency - flow cup (report to the nearest second)	214.2	
pH of Water-based Paints (report to the nearest 0.1 pH unit)	505.1	
Measurement of specular gloss (60°) (report to 2 decimal places)	602.2	

NOTES:

1. Report the nominal volume of the pycnometer used for AS1580.202.1.
2. Report make and model of pH meter used.
3. AS1580.602.2 Measurement of specular gloss - readings shall be taken with 60° angle of incidence as per 10.2.

Signed: _____

Date: _____

Results are to be returned to PTA by 20 MARCH 2020.

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- End of Report -