

Report No. 1174

Bitumen

Proficiency Testing Program

Round 11

January 2020

Acknowledgments

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1. FOREWORD

This report summarises the results of a proficiency testing program on the determination of selected chemical tests of bitumen. It constitutes the eleventh 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 2019 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 and the Technical Adviser was Dr B Chik, SAMI Bitumen Technologies Pty Ltd. This report was authorised by Mr P. Briggs, General Manager, PTA.

2. FEATURES OF THE PROGRAM

- (a) Participants were provided with one 700ml sample labelled PTA Sample A.
- (b) A total of 30 laboratories received samples, comprising:
 - 25 Australian participants; and
 - 5 overseas participants, including:
 - New Zealand (1);
 - Qatar (1);
 - UAE (1);
 - Singapore (1); and
 - Trinidad and Tobago (1).

Of these 30 laboratories, one was 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, 2019* (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 9.

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 9 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 decimal places) requested on the Results Sheet have not been rounded to the requested precision before being included in the statistical analysis.

A list of summary statistics appears at the bottom of each of the 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.

The following tables summarise the results submitted by participants for the program.

TABLE A1: SUMMARY STATISTICS

Test	No. of Results	Median	Normalised IQR
Viscosity at 135.0°C (0.001 Pa.s)	26	0.3780	0.0174
Density at 15.0°C (bottle) (0.1 Kg/m ³)	24	1037.50	1.22
Penetration 25.0°C, 100g, 5s (0.1 mm)	31	68.00	2.34
Softening Point, (0.2°C)	29	48.40	0.59
Viscosity at 60.0°C (0.1 Pa.s)	30	179.30	3.87
Penetration Index	22	-0.9278	0.2274

TABLE A2: SUMMARY STATISTICS when an AS oven was used

Test	No. of Results	Median	Normalised IQR
Viscosity at 60.0°C After RTFO Treatment (0.1 Pa.s)	16	364.00	20.92
Viscosity at 60.0°C as % of Original After RTFO Treatment	16	202.50	16.49

TABLE A3: SUMMARY STATISTICS when an ASTM oven was used

Test	No. of Results	Median	Normalised IQR
Viscosity at 60.0°C After RTFO Treatment (0.1 Pa.s)	6	413.10	40.55
Viscosity at 60.0°C as % of Original After RTFO Treatment	6	229.1	26.4

5. PTA AND TECHNICAL ADVISER'S COMMENTS

Out of 30 participating laboratories (25 Australian and 5 overseas), one laboratory did not submit results in time to be included in the final report.

A total of nine laboratories have been identified as having reported one or more outlier results, as depicted in table D. From a total of 218 results, 17 outliers have been identified, representing 7.8%. In general, there are similar statistical outliers in Round 11 when compared to previous PT rounds (7.6% in Round 10 and 11.03% in Round 9). This indicates a good overall performance taking into consideration the measurement uncertainty.

All laboratories with outliers or an absolute z-score between 2.0 and 3.0 are encouraged to review their procedures. The overall performance of the laboratories was good and generally in line with previous rounds of proficiency testing.

Results were separated into two groups for analysis of Viscosity at 60.0°C after RTFO treatment and Viscosity at 60.0°C as percentage of original after RTFO treatment, according to the oven which was used during testing. The type of oven can influence the results, due to a major difference in their technical design: the ASTM RTFO-type of oven has a big fan on top of the oven, while the Australian design RTFO-type of oven does not. Participants are encouraged to report their results from both types of ovens if available. It might also be beneficial for Australian laboratories to be equipped with both types of ovens. Results for viscosity at 60.0°C were pooled as the type of oven used does not influence the results.

The performance of different operators in the same laboratory was very similar. For example laboratory code 8 participated in this program with two operators (8A and 8B). A similar performance was observed across various tests.

A possible source of error in the determination of viscosity at 60°C is the application of a capillary viscometer tube that is not clean enough. A possible error in density measurement is that the water in the 25°C bath is unclean. The water in the 25°C bath should be kept clean at all times.

The following table gives a comparison of the robust CVs and percentage of outliers for tests common to previous programs.

TABLE B: COMPARISON OF ROBUST CVs AND PERCENTAGE OF OUTLIERS

Test	Round 9		Round 10		Round 11	
	CV	% Outliers	CV	% Outliers	CV	% Outliers
Viscosity at 135.0°C (0.001 Pa.s)	3.4%	9.1%	6.3%	3.4%	4.6%	3.7%
Density at 15.0°C (Bottle) (0.1 Kg/m ³)	0.2%	25%	0.2%	5.2%	0.1%	12.0%
Penetration 25.0°C, 100g, 5s (0.1 mm)	4.7%	8%	6.8%	9.6%	3.4%	9.7%
Softening Point (0.2°C)	1.5%	8.7%	1.1%	7.4%	1.2%	13.8%
Viscosity at 60.0°C (0.1 Pa.s)	1.7%	13%	3.5%	8.3%	2.2%	10.0%
Viscosity at 60.0°C After RTFO Treatment (0.1 Pa.s)	AS: 3.3% ASTM: 7.0%	AS: 7.7% ASTM: -	AS: 6.2% ASTM: 3.5%	AS: - ASTM: 16.6%	AS: 5.7% ASTM: 9.8%	AS:12.5% ASTM: -
Viscosity at 60.0°C as % of Original After RTFO Treatment	AS: 2.7% ASTM: 7.8%	AS: 15.4% ASTM: -	AS: 6.0% ASTM: 2.3%	AS: - ASTM: 16.6%	AS: 8.1% ASTM: 11.5%	AS: - ASTM: -
Penetration Index	N/A	N/A	-19.6%	16.6%	-24.5%	4.5%
Total % of outliers	11.03%		7.6%		7.8%	

Notes: “-“ indicates that no outliers were detected. “N/A” indicates not applicable

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.

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. Results for Viscosity at 130°C, Density at 15°C, Penetration at 25°C, softening Point and Viscosity at 60°C each returned at least 11 sets of results from the same method group. The results are tabulated below.

TABLE C: ANALYSIS BY GROUPED METHODS

Test	Method	No. of Results	Median	Uncertainty of the Median
Viscosity at 135.0°C	AS 2341.4	14	0.3845	0.0079
Density at 15.0°C	AS 2341.7	20	1037.50	0.30
Penetration at 25.0°C	AS 2341.12	25	68.00	0.56
Softening Point	AS 2341.18	20	48.40	0.18
Viscosity at 60.0°C	AS 2341.2	23	179.70	0.73

6. OUTLIER RESULTS

Laboratories reporting outlier results are listed in the following table:

TABLE D: SUMMARY OF STATISTICAL OUTLIERS

Test	Laboratory Code No.
Viscosity at 135.0°C	29
Density at 15.0°C (Bottle)	5, 29, 30
Penetration 25.0°C, 100g, 5s	5,7,30
Softening Point	2,7,14,30
Viscosity at 60.0°C	3, 7, 10
Viscosity at 60.0°C after RTFO Treatment	7, 22
Penetration Index	30

7. REFERENCE

- [1] *Guide to Proficiency Testing Australia*, 2019 (This document can be found on the PTA website, www.pta.asn.au)

APPENDIX A

Results and Data Analysis

Viscosity at 135.0°C	A1
Density at 15.0°C (Bottle)	A3
Penetration 25.0°C, 100g, 5s	A5
Softening Point	A7
Viscosity at 60.0°C	A9
Viscosity at 60.0°C after RTFO Treatment.....	A11
Viscosity at 60.0°C as % of original after RTFO Treatment.....	A15
Penetration Index.....	A19
Additional Information.....	A21

Viscosity at 135.0°C (0.001 Pa.s)				
Lab Code	Result	MU	Z-Score	Method
1	0.356	#	-1.21	AS2341.2
3	0.374	0.093	-0.17	AS2341.4
4	0.379	#	0.11	AS2341.2
5	0.336	0.02	-2.35	? ASTM D 4402.2013
7	0.398	#	1.21	AS/NZS2341.4
8A	0.349	#	-1.61	AS2341.4
8B	0.356	#	-1.21	AS2341.4
11A	0.401	#	1.38	AS2341.4
11B	0.401	#	1.38	AS2341.4
12	0.376	#	-0.06	AS2341.2
16	0.401	#	1.38	AS/NZ 2341.4
17	0.358	#	-1.09	AS2341.4
18	0.395	#	1.03	AS2341.4
19	0.370	0.12	-0.40	AS2341.4
20	0.380	#	0.17	AS2341.4
21	0.400	0.12	1.32	AS2341.4
22	0.374	#	-0.17	AS2341.2
23	0.379	#	0.11	AS2341.3
24	0.389	#	0.69	AS2341.4
25	0.384	#	0.40	AS2341.3
26	0.408	#	1.78	AG:PT/T111
27A	0.373	#	-0.23	AS/NZ 2341.2
27B	0.378	#	0.06	AS/NZ 2341.2
28A	0.370	#	-0.40	AS/NZS 2341.2
28B	0.370	#	-0.40	AS/NZS 2341.2
29	360.3	0.01	‡	§ ASTM D 2170
30	0.367	#	-0.57	AS2341.4

No of Results	26
Median	0.3770
Norm IQR	0.0174
Uncertainty (Median)	0.0043
Robust CV	4.6%
Minimum	0.336
Maximum	0.408
Range	0.072

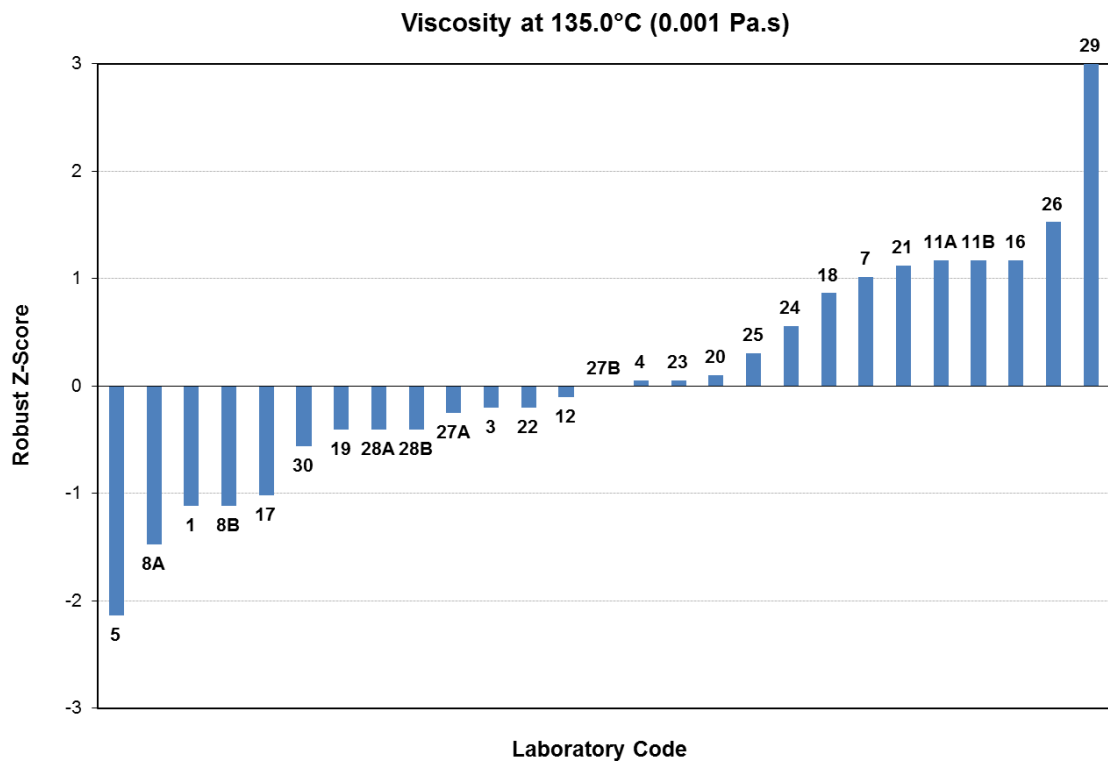
"?" indicates an absolute z-score greater than 2.0 but less than 3.0,

"§" indicates an outlier

"#" indicates no response was provided by the laboratory

"na" indicates not applicable

"‡" result excluded from statistical analysis



Density at 15.0°C (bottle) (0.1 kg/m ³)					
Lab Code	Result	MU	Z-Score		Method
1	1038.0	#	0.41		AS2341.7
2	1036.1	#	-1.14		ASTM D70
3	1037.0	3.34	-0.41		AS2341.7
4	1038.0	#	0.41		AS2341.7
5	1050.0	#	10.22	§	ASTM D70.2009
7	1038.0	#	0.41		AS2341.7/ASTMD4311
8A	1035.7	#	-1.47		AS2341.7
8B	1036.4	#	-0.90		AS2341.7
12	1037.6	#	0.08		AS2341.7
13	1037.4	#	-0.08		AS2341.7
14	1036.2	#	-1.06		ASTMD70
18	1038.1	#	0.49		AS2341.7
19	1036.8	0.9	-0.57		AS2341.7
20	1038.8	#	1.06		AS2341.7
21	1037.6	0.9	0.08		AS2341.7
22	1035	#	-2.04	?	AS2341.7
23	1037.2	#	-0.25		AS2341.7
24	1036.6	#	-0.74		AS2341.7
25	1038.3	#	0.65		AS2341.7
27A	1038.3	#	0.65		AS2341.7
27B	1035.3	#	-1.80		AS2341.7
28A	1037.8	#	0.25		AS2341.7
28B	1038.0	#	0.41		AS2341.7
29	1028.5	1	-7.36	§	ASTM D70
30	1.0	#	‡	§	AS2341.7

No of Results	24
Median	1037.50
Norm IQR	1.22
Uncertainty (Median)	0.31
Robust CV	0.1%
Minimum	1028.5
Maximum	1050.0
Range	21.5

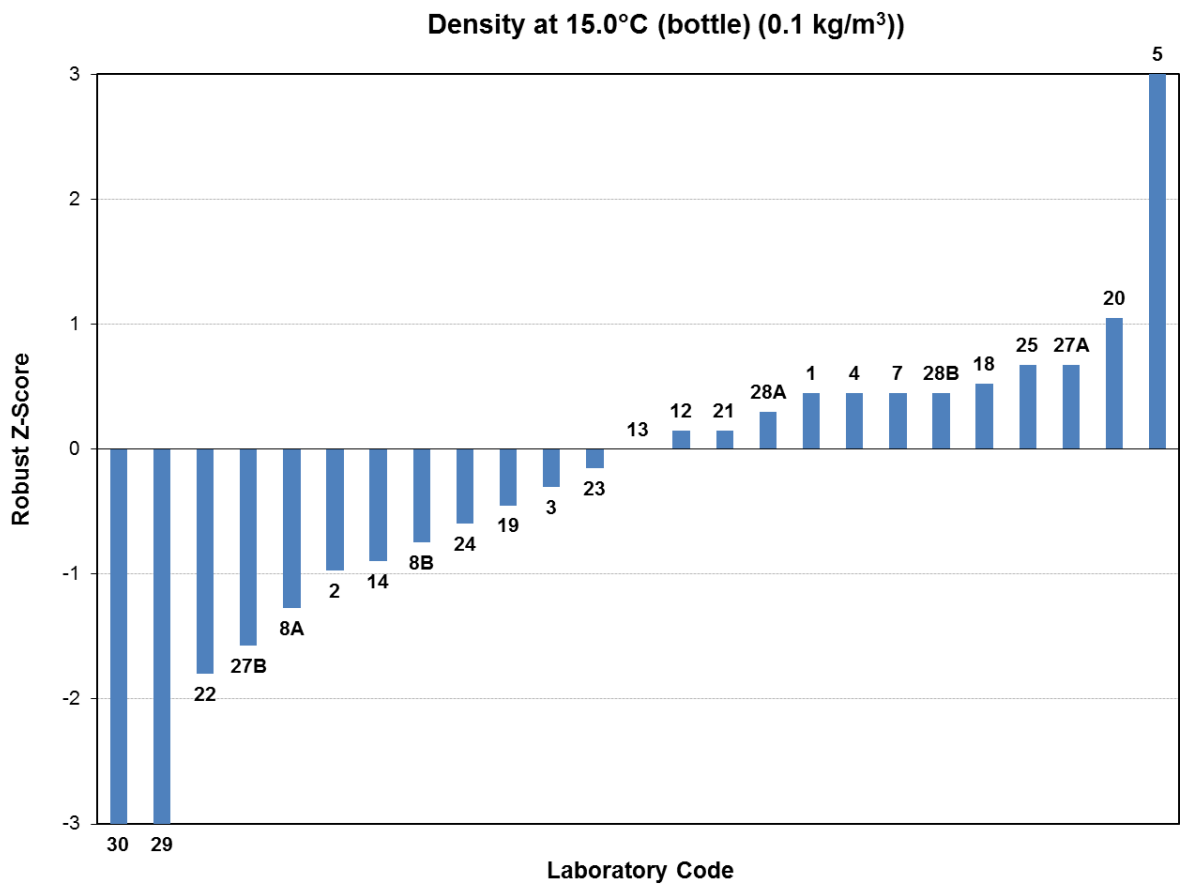
"?" indicates an absolute z-score greater than 2.0 but less than 3.0,

"§" indicates an outlier

"#" indicates no response was provided by the laboratory

"na" indicates not applicable

"‡" result excluded from statistical analysis



Penetration 25.0°C, 100g, 5s (0.1 mm)				
Lab Code	Result	MU	Z-Score	Method
1	70	#	0.86	AS 2341.12
2	66.3	#	-0.73	ASTM D5
3	65.0	#	-1.28	AS 2341.12
4	67.4	#	-0.26	AS 2341.12
5	78	1.24	4.28	§ ASTM D5.2013
6	71	#	1.28	ASTM D5
7	7.4	#	-25.95	§ AS 2341.12
8A	65	#	-1.28	AS 2341.12
8B	65	#	-1.28	AS 2341.12
11A	70.3	#	0.98	AS 2341.12
11B	69.8	#	0.77	AS 2341.12
12	69.2	#	0.51	AS 2341.12
13	71	#	1.28	AS 2341.12
14	67.0	#	-0.43	ASTM D5
16	67.0	#	-0.43	AS/NZ 2341.12
17	67.0	#	-0.43	AS/NZ 2341.12
18	71.7	#	1.58	AS 2341.12
19	69	4	0.43	AS 2341.12
20	66.0	#	-0.86	AS 2341.12
21	67	4	-0.43	AS 2341.12
22	71	#	1.28	AS 2341.12
23	68.0	#	0.00	AS 2341.12
24	71	#	1.28	AS 2341.12
25	67	#	-0.43	AS 2341.12
26	67.8	#	-0.09	AG:PT/T131/AS2304.18
27A	69	#	0.43	AS 2341.12
27B	70	#	0.86	AS 2341.12
28A	67	#	-0.43	AS 2341.12
28B	67	#	-0.43	AS 2341.12
29	70	2	0.86	ASTM D5
30	75.2	#	3.08	§ AS 2341.12

No of Results	31
Median	68.00
Norm IQR	2.34
Uncertainty (Median)	0.53
Robust CV	3.4%
Minimum	7.4
Maximum	78.0
Range	70.6

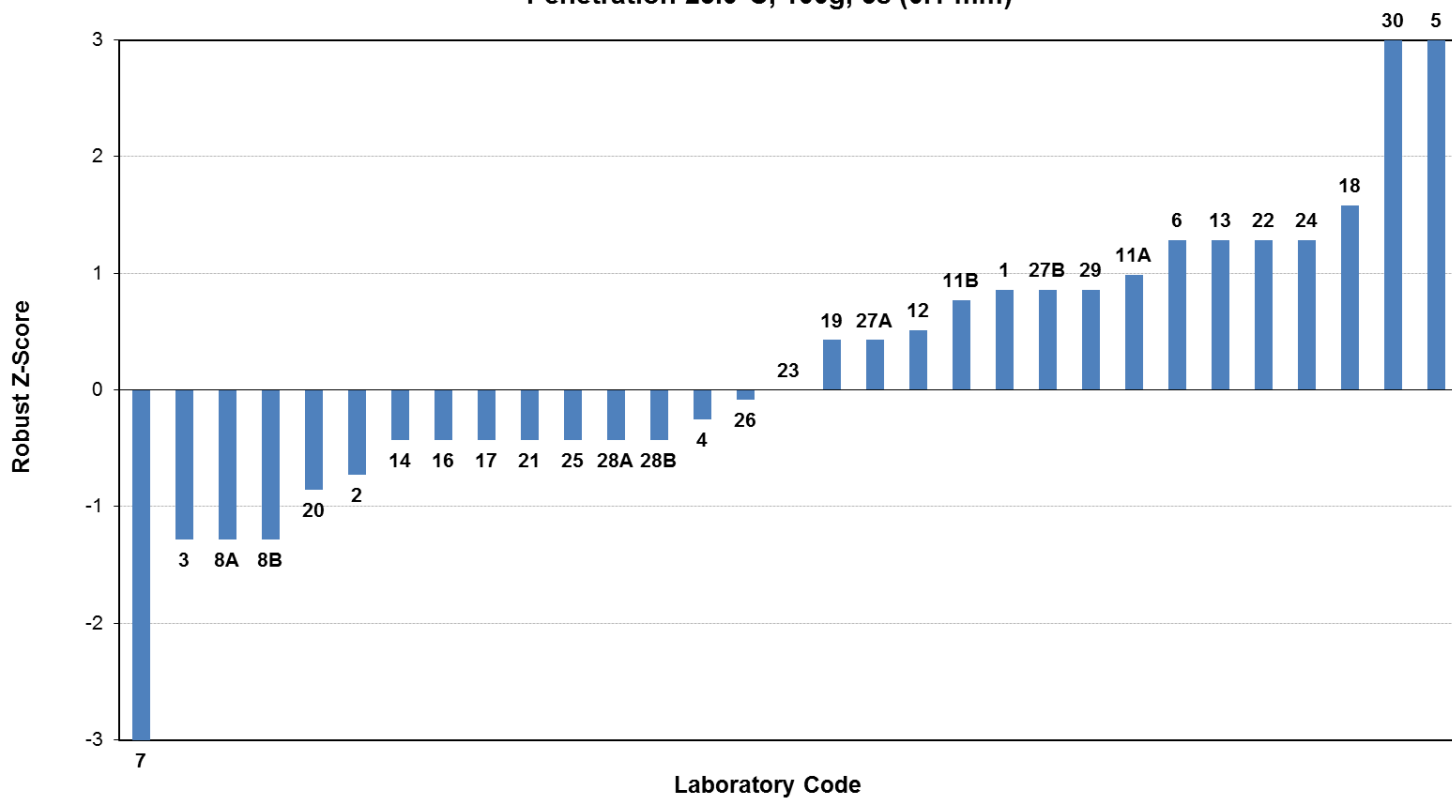
"?" indicates an absolute z-score greater than 2.0 but less than 3.0,

“§” indicates an outlier

"#" indicates no response was provided by the laboratory

"na" indicates not applicable

Penetration 25.0°C, 100g, 5s (0.1 mm)



Softening Point (0.2°C)					
Lab Code	Result	MU	Z-Score		Method
1	50	#	2.70	?	AS2341.18
2	51.0	#	4.38	§	ASTM D36
3	49.0	4.2	1.01		AS2341.18
5	48.0	1.39	-0.67		ASTM D36 2012
6	48.2	#	-0.34		ASTM D36
7	46.0	#	-4.05	§	AS2341.18
8A	48.5	#	0.17		AS2341.18
8B	48.5	#	0.17		AS2341.18
11A	48.8	#	0.67		AS2341.18
11B	48.0	#	-0.67		AS2341.18
12	48.0	#	-0.67		AS2341.18
13	48.4	#	0.00		AS2341.18
14	44.0	#	-7.42	§	ASTM D36
15A	48.8	#	0.67		#
15B	48.6	#	0.34		#
16	48.0	#	-0.67		AS2341.18
17	47.0	#	-2.36	?	AS2341.18
18	48.6	#	0.34		AS2341.18
20	48.4	#	0.00		AS2341.18
21	48.0	2	-0.67		AS2341.18
22	48.0	#	-0.67		ASTM D36
24	48.0	#	-0.67		AS2341.18
26	49.2	#	1.35		AG:PT/T131/AS2304.18
27A	48.0	#	-0.67		AS2341.18
27B	49	#	1.01		AS2341.18
28A	47.0	#	-2.36	?	AS2341.18
28B	49.5	#	1.85		AS2341.18
29	47.2	2	-2.02	?	ASTM D36
30	51.4	#	5.06	§	AS2341.18

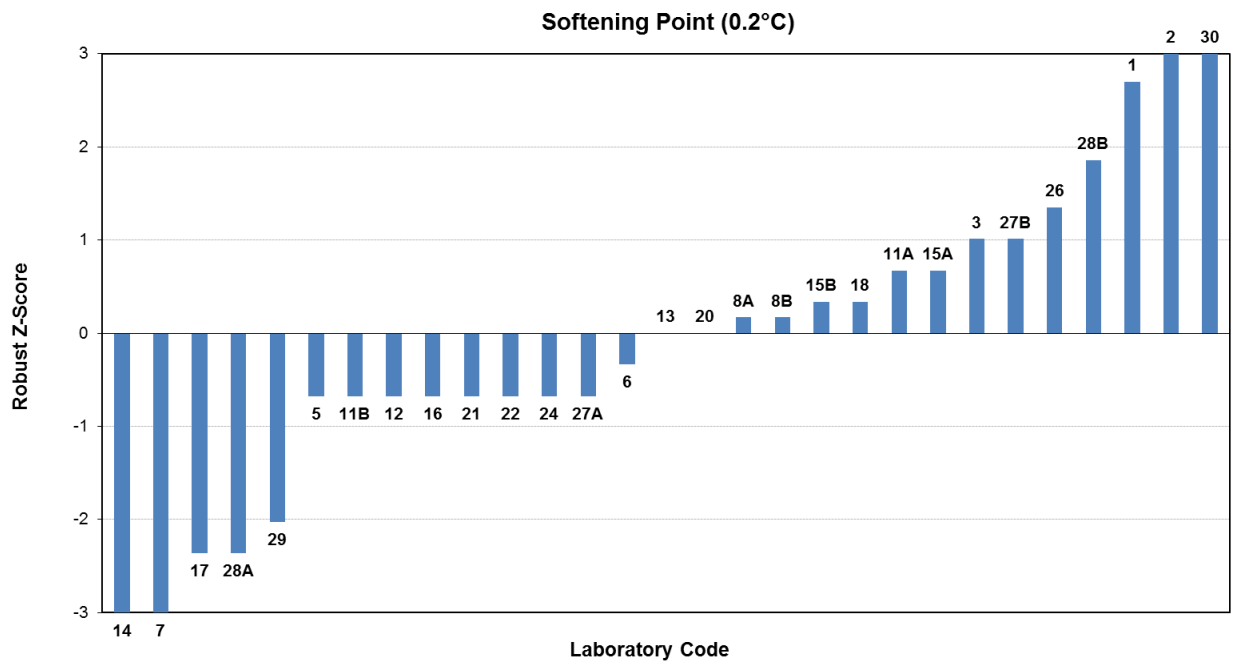
No of Results	29
Median	48.40
Norm IQR	0.59
Uncertainty (Median)	0.14
Robust CV	1.2%
Minimum	44.0
Maximum	51.4
Range	7.4

"?" indicates an absolute z-score greater than 2.0 but less than 3.0,

"§" indicates an outlier

"#" indicates no response was provided by the laboratory

"na" indicates not applicable



Viscosity at 60.0°C (0.1 Pa.s) AS+ASTM				
Lab Code	Result	MU	Z-Score	Method
1	173	#	-1.63	AS 2341.2
3	216.3	11	9.55	§ AS 2341.2
4	176.4	#	-0.75	AS 2341.2
5	168.7	0.012	-2.74	? ASTM D 4402.2013
7	192.7	#	3.46	§ AS 2341.2
8A	179	#	-0.08	AS2341.2
8B	182.0	#	0.70	AS2341.2
10	167	#	-3.18	§ SAAL viscometer
11A	181.7	#	0.62	AS2341.2
11B	179.7	#	0.10	AS2341.2
12	179.8	#	0.13	AS 2341.2
13	174.8	#	-1.16	AS 2341.2
15A	180.2	#	0.23	#
15B	177.8	#	-0.39	#
16	172.0	#	-1.88	AS/NZ 2341.4
17	187.0	#	1.99	AS/NZ 2341.8
18	179.3	#	0.00	AS 2341.2
19	175.0	0.12	-1.11	AS 2341.2
20	181.8	#	0.65	AS 2341.2
21	181.0	0.12	0.44	AS 2341.2
22	180.3	#	0.26	AS 2341.2
23	179.3	#	0.00	AS 2341.2
24	177.5	#	-0.46	AS 2341.2
25	185	#	1.47	AS 2341.2
27A	179	#	-0.08	AS/NZS 2341.2
27B	183	#	0.96	AS/NZ 2341.2
28A	182	#	0.70	AS/NZS 2341.2
28B	177	#	-0.59	AS/NZS 2341.2
29	175	12	-1.11	ASTM D 2171
30	178.8	#	-0.13	AS 2341.2

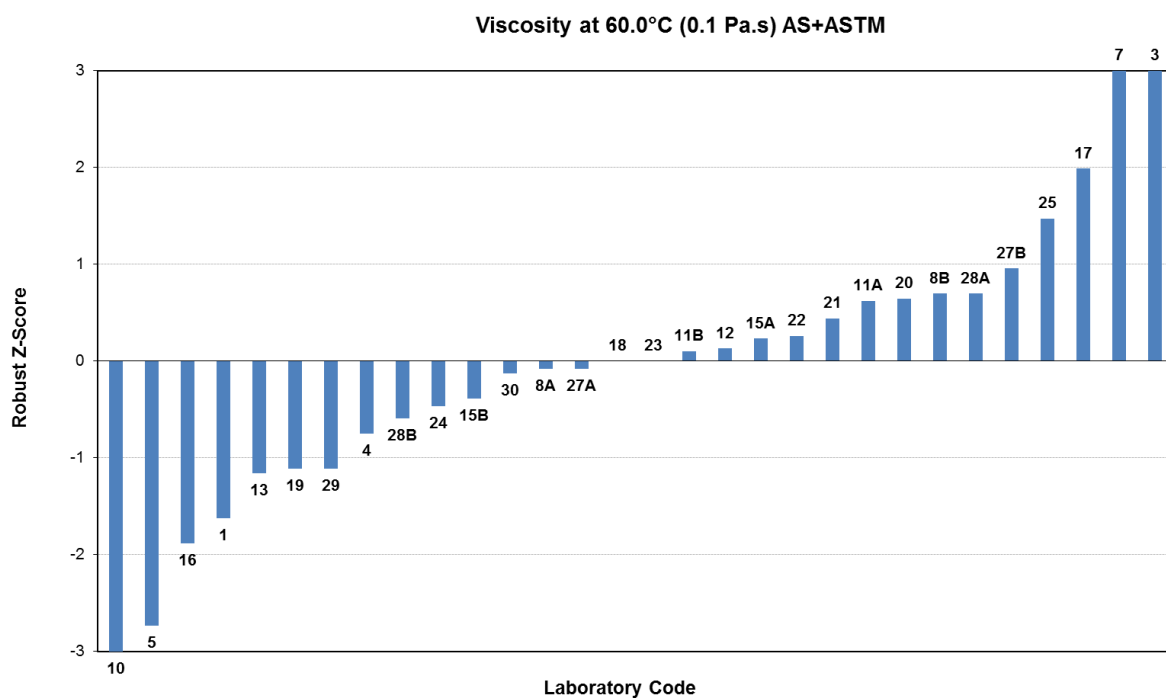
No of Results	30
Median	179.30
Norm IQR	3.87
Uncertainty (Median)	0.89
Robust CV	2.2%
Minimum	167.0
Maximum	216.3
Range	49.3

"?" indicates an absolute z-score greater than 2.0 but less than 3.0,

"§" indicates an outlier

"#" indicates no response was provided by the laboratory

"na" indicates not applicable



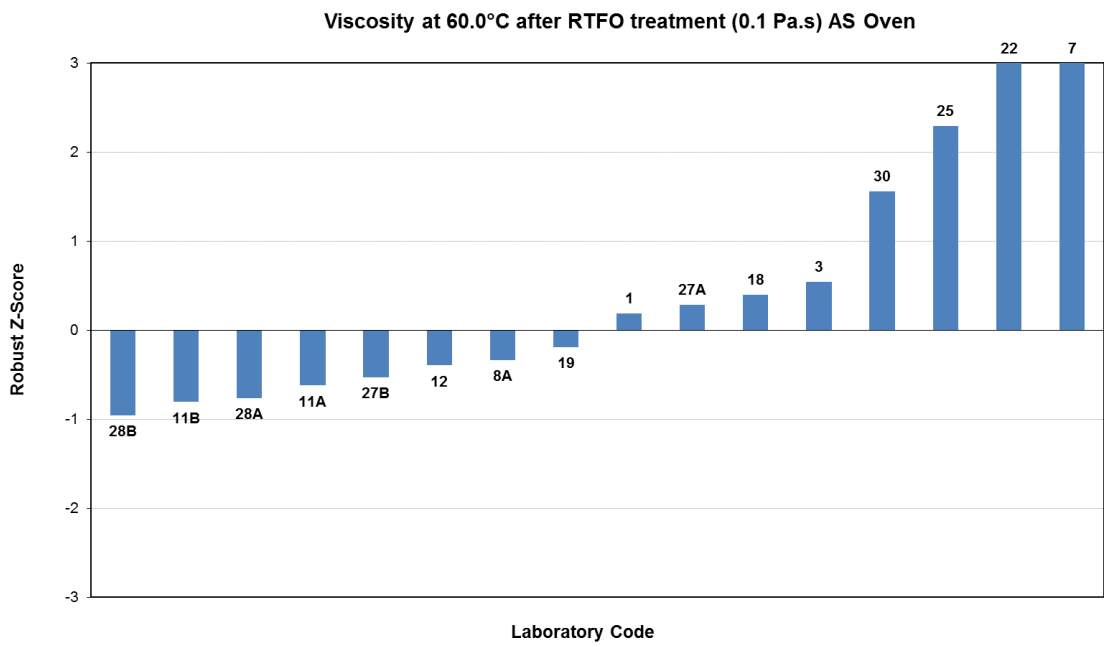
Viscosity at 60.0°C after RTFO treatment (0.1 Pa.s) AS Oven					
Lab Code	Result	MU	Z-Score		Method
1	368	#	0.19		AS/NZ 2341.10
3	375.4	41.61	0.54		AS/NZ 2341.10 & 2
7	468.5	#	4.99	§	AS/NZS 2341.10 AS/NZS 2341.2
8A	357	#	-0.33		AS 2341.2
11A	351.0	#	-0.62		AS 2341.10/AS 2341.2
11B	347.1	#	-0.81		AS 2341.10/AS 2341.2
12	355.7	#	-0.40		AS 2341.2/AS 2341.10
18	372.4	#	0.40		AS 2341.10 AS 2341.2
19	360.0	0.20	-0.19		AS 2341.10 AS 2341.2
22	434.4	#	3.36	§	AS 2341.10 AS 2341.2
25	412	#	2.29	?	AS2341.2
27A	370	#	0.29		AS/NZS 2341.2
27B	353	#	-0.53		AS/NZ 2341.2
28A	348	#	-0.76		AS/NZS 2341.2
28B	344	#	-0.96		AS/NZS 2341.2
30	396.7	#	1.56		AS 2341.10

No of Results	16
Median	364.00
Norm IQR	20.92
Uncertainty (Median)	6.56
Robust CV	5.7%
Minimum	344.0
Maximum	468.5
Range	124.5

"?" indicates an absolute z-score greater than 2.0 but less than 3.0,

"#" indicates no response was provided by the laboratory

"na" indicates not applicable



Viscosity at 60.0°C after RTFO treatment (0.1 Pa.s) ASTM Oven				
Lab Code	Result	MU	Z-Score	Method
5	447.7	0.012	0.85	ASTM D4402.2013
8B	362	#	-1.26	AS 2341.10/AS 2341.2
13	409.3	#	-0.09	AS 2341.2
17	418.0	#	0.12	AS/NZ 2341.2 +10
21	363.0	0.20	-1.24	AS 2341.10 AS 2341.2
24	416.9	#	0.09	AS2341.2

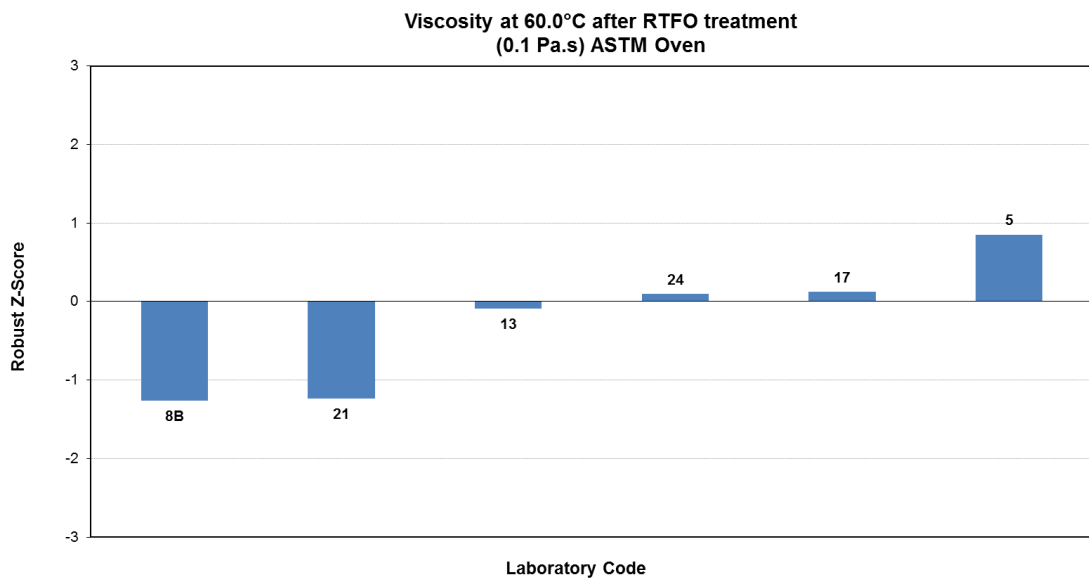
No of Results	6
Median	413.10
Norm IQR	40.55
Uncertainty (Median)	20.75
Robust CV	9.8%
Minimum	362.0
Maximum	447.7
Range	85.7

"?" indicates an absolute z-score greater than 2.0 but less than 3.0,

"\$" indicates an outlier

"#" indicates no response was provided by the laboratory

"na" indicates not applicable



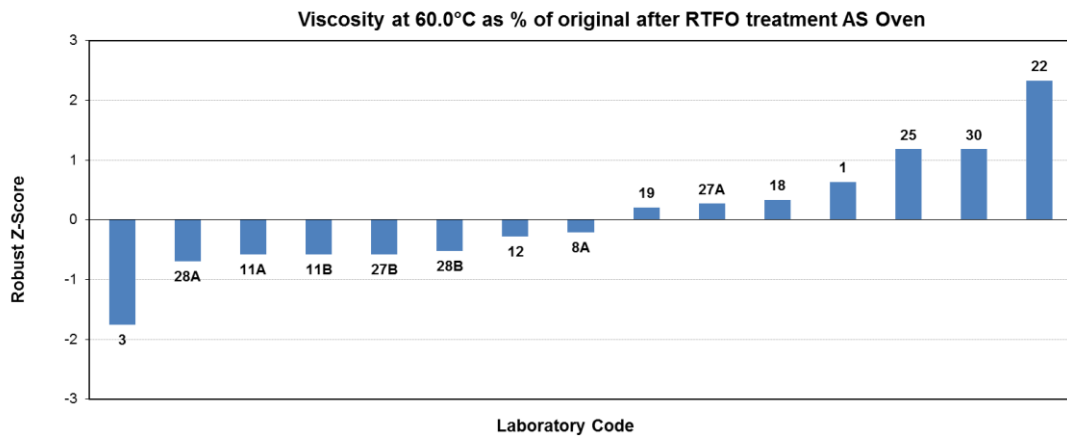
Viscosity at 60.0°C as % of original after RTFO treatment AS Oven					
Lab Code	Result	MU	Z-Score		Method
1	213	#	0.64		AS/NZ 2341.10
3	173.5	21.1	-1.76		AS/NZ 2341.10 & 2
7	243	#	2.46	?	AS/NZS 2341.10 AS/NZS 2341.2
8A	199	#	-0.21		AS2341.10
11A	193	#	-0.58		AS 2341.10/AS 2341.2
11B	193	#	-0.58		AS 2341.10/AS 2341.2
12	198	#	-0.27		AS 2341.10
18	208	#	0.33		AS 2341.10 AS 2341.2
19	206	15%	0.21		AS 2341.10 AS 2341.2
22	241	#	2.33	?	AS 2341.10 AS 2341.2
25	222	#	1.18		calcuation
27A	207	#	0.27		AS/NZS 2341.10
27B	193	#	-0.58		AS/NZ 2341.10
28A	191	#	-0.70		AS/NZS 2341.10
28B	194	#	-0.52		AS/NZS 2341.10
30	222	#	1.18		#

No of Results	16
Median	202.5
Norm IQR	16.5
Uncertainty (Median)	5.2
Robust CV	8.1%
Minimum	174
Maximum	243
Range	70

"?" indicates an absolute z-score greater than 2.0 but less than 3.0,

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"na" indicates not applicable



Viscosity at 60.0°C as % of original after RTFO treatment ASTM Oven				
Lab Code	Result	MU	Z-Score	Method
5	265	#	1.36	#
8B	199	#	-1.14	#
13	234.2	#	0.19	AS 2341.2
17	224	#	-0.19	AS/NZ 2341.10
21	201	#	-1.07	AS 2341.10 AS 2341.2
24	235	#	0.22	#

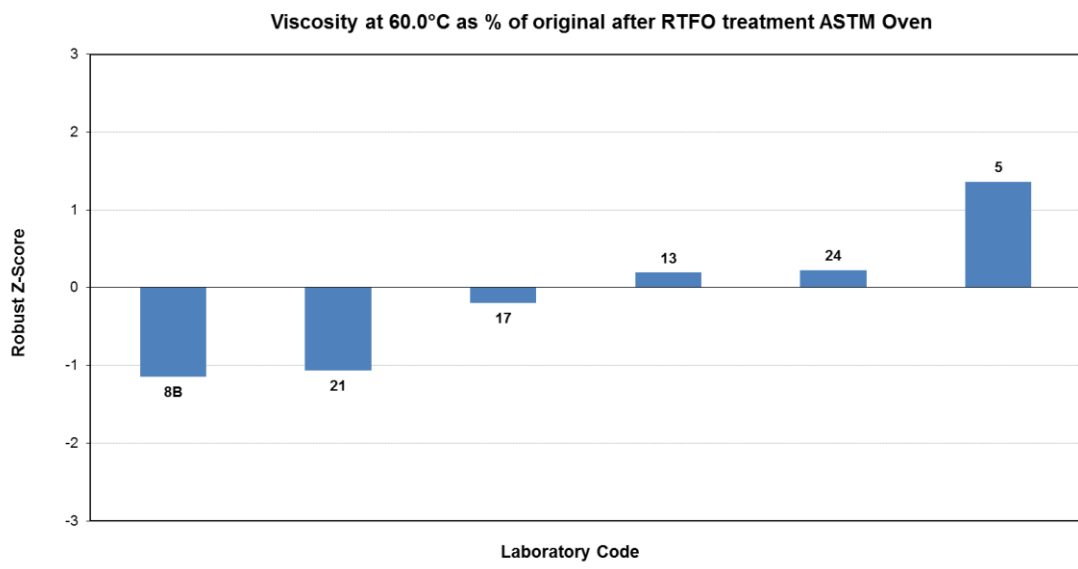
No of Results	6
Median	229.1
Norm IQR	26.4
Uncertainty (Median)	13.5
Robust CV	11.5%
Minimum	199
Maximum	265
Range	66

"?" indicates an absolute z-score greater than 2.0 but less than 3.0,

"§" indicates an outlier

"#" indicates no response was provided by the laboratory

"na" indicates not applicable



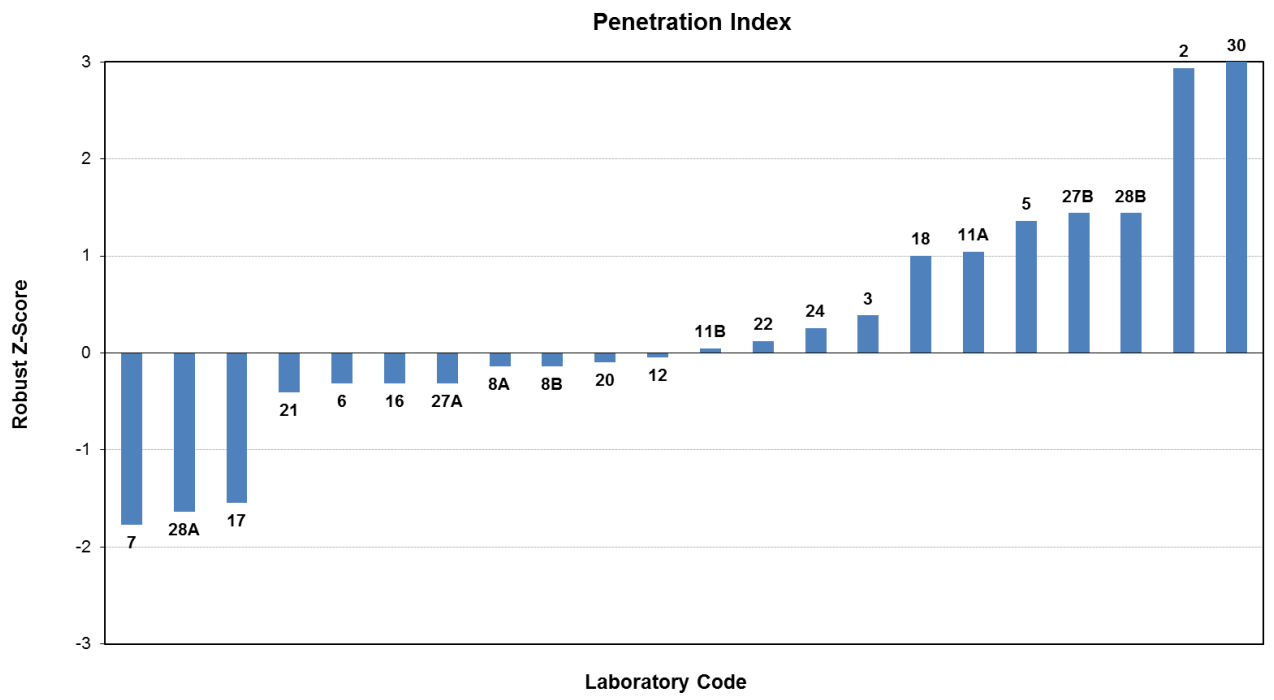
Penetration Index			
Lab Code	Result	Z-Score	
2	-0.26	2.94	?
3	-0.84	0.39	
5	-0.6186	1.36	
6	-1	-0.32	
7	-1.33	-1.77	
8A	-0.96	-0.14	
8B	-0.96	-0.14	
11A	-0.691	1.04	
11B	-0.9165	0.05	
12	-0.939	-0.05	
16	-1.00	-0.32	
17	-1.28	-1.55	
18	-0.70	1.00	
20	-0.95	-0.10	
21	-1.02	-0.41	
22	-0.9	0.12	
24	-0.87	0.25	
27A	-1	-0.32	
27B	-0.6	1.44	
28A	-1.3	-1.64	
28B	-0.6	1.44	
30	0.1873	4.90	§

No of Results	22
Median	-0.9278
Norm IQR	0.2274
Uncertainty (Median)	0.0608
Robust CV	-24.5%
Minimum	-1.330
Maximum	0.187
Range	1.517

“§” indicates an outlier

"#" indicates no response was

"na" indicates not applicable



Additional Information							
Laboratory Code	Measured RTFOT temperature (0.1°C)		Make and Model of Rotational Viscometer	Mean Shear Rates for All Viscosities Tested		Filling Method in Determination of Density at 15°C	Cannon-Manning or Asphalt Institute Viscometer Used?
	AS	ASTM		135°C	60°C		
1	163	#	#	#	#	Partial filling	Cannon-Manning
2	#	#	#	#	#	#	#
3	162.8	#	RVDV II +, Brookfield	39.6 S-1	1.24 S-1 & 1.44 S-1	Partial	Asphalt Institute
4	#	#	#	#	#	Partial	Cannon-Manning
5	#	163	Brokfield DVII +	46.50 S-1	0.75 S-1	Partial	#
6	#	#	#	#	#	#	#
7	163	#	DV II + Pro	28	#	Partial	Cannon-Manning
8A	163.0	#	#	34	0	Partial	Asphalt Institute
8B	163	#	#	34 S-1	#	Partial	A1
10	#	#	#	#	#	#	#
11A	163.5	#	LV D-VI Prime	#	#	#	Asphalt Institute
11B	163.5	#	LV D-VI Prime	#	#	#	Asphalt Institute
12	163	#	0	1128.0	1.442	Partial Fill	AL 100 for 60 C° & CM-8 for 135 C°
13	163	#	#	#	#	#	Asphalt Institute Viscometer
14	#	#	#	#	#	#	#
15A	#	#	#	#	#	#	Asphalt Institute
15B	#	#	#	#	#	#	Asphalt Institute

Additional Information (Continuation)							
Laboratory Code	Measured RTFOT temperature (0.1°C)		Make and Model of Rotational Viscometer	Mean Shear Rates for All Viscosities Tested		Filling Method in Determination of Density at 15°C	Cannon-Manning or Asphalt Institute Viscometer Used?
	AS	ASTM		135°C	60°C		
16	#	#	SARU-INT-09B-41	#	#	#	#
17	162.8	#	Brookfield DV2T	#	#	#	100 tubes
18	163	#	Brookfield LVD VII +	20.4 S-1	1.38 S-1	Partial	Asphalt Institute
19	163	#	Brookfield RVDV2	34 S-1	1.53 S-1	Partial filling	Asphalt Institute
20	#	#	LVD V2T DX2TLVKJO	34	#	Partial filling	Cannon-Manning
21	#	163	Brookfield LCDV2	20.4 S-1	1.5 S-1	Partial filling	Asphalt Institute
22	163.2	#	#	#	#	Partial filling	Cannon-Manning
23	#	#	#	#	#	Partial	Cannon-Manning
24	#	163	DV II + Brookfiled	112	#	Partial filling	Cannon-Manning
25	162	#	#	#	1.37	Partial filling	Asphalt Institute
26	#	#	Brookfield LVDV II +	23.8	#	#	#
27A	163	#	#	1075.3	1.43	#	AI @60 C cm@135 C
27B	163	#	#	1075.3	1.43	#	AI @60 C cm@135 C
28A	163	#	#	1099.1	1.43	Partial	AI @60 C cm@135 C
28B	163	#	#	1096.6	1.43	Partial	AI @60 C cm@135 C
29	#	#	#	#	#	Partial filling	Cannon
30	163.2	#	Brookfield LV	11.16	160	Partial	#

APPENDIX B

Homogeneity Testing

Homogeneity Testing

The samples utilised in this program were supplied by SAMI Bitumen Technologies Pty Ltd, Camellia Laboratory. For this program, ten 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.

Penetration at 25°C AS 2341.12

Sample no.	Results p.u.	Deviation
13	82	0.7264
20	84	-1.6949
29	81	1.9370
35	81	1.9370
50	83	-0.4843
51	84	-1.6949
58	84	-1.6949
64	82	0.7264
Average	82.6	

Viscosity at 135°C AS 2341.4

Results Pa.s.	Deviation
0.397	0.37641
0.398	0.12547
0.400	-0.37641
0.400	-0.37641
0.410	-2.88582
0.390	2.13300
0.410	-2.88582
0.390	2.13300
0.3985	

Water bath temperature checked = 25°C

Thermosel temperature checked = 135°C

Deviation lies within test method requirements

APPENDIX C

Documentation

Instructions to Participants	C1
Results Sheet	C3

**PROFICIENCY TESTING AUSTRALIA
BITUMEN PROFICIENCY TESTING PROGRAM**

ROUND 11

INSTRUCTIONS TO PARTICIPANTS

To ensure that results from this program can be analysed properly, participants are asked to adhere carefully to the following instructions.

1. One 700 ml sample containing bitumen C170 is provided to each laboratory.
2. The following tests are to be conducted:
 - Dynamic Viscosity at 135^oC
 - Density at 15C (density bottle)
 - Penetration 25^oC, 100g, 5s
 - Softening Point, ^oC
 - Penetration Index
 - Viscosity at 60^oC
 - Viscosity at 60^oC after RTFO treatment
 - Viscosity at 60^oC as percentage of original after RTFO treatment
3. Participants can perform any or all of the above mentioned tests. Participants are to treat the proficiency testing samples as they would be as a routine sample tested in the laboratory.
4. Participants are encouraged to perform “Viscosity at 60^oC after RTFO treatment” using both AS and ASTM ovens.
5. Please report oven (RTFO) temperature applied during RTFOT. Measure RTFOT temperature using a calibrated thermometer because some ovens have misleading temperature readings.
6. For calculation of the Penetration Index, the following formula has to be used:
$$PI = (20-500A)/(1+50A)$$
where A = (log pen_{25C} - log800)/(25 - ASTM softening point), assuming “AS” and “ASTM” softening points are the same.

Determine the softening point and penetration at 25^oC and apply the computer programme to establish the PI.
7. Participants may use the routine test methods which would normally be used to test samples. Please identify the method used on the Results Sheet.

8. Laboratories are also requested to calculate and report an estimate of uncertainty of measurement for each reported measurement result if possible. All estimates of uncertainty of measurement must be given as a 95% confidence interval (coverage factor $k \approx 2$) and reported in \pm reporting unit basis.
9. The results for all determinations are to be recorded on the results sheet to the accuracy and reporting basis indicated.
10. Testing may commence as soon as the sample is received. All laboratories must return the results sheet no later than **22 November 2019** to:

Dr Michael Li
Proficiency Testing Australia
Phone: 02 9736 8397
Fax: 02 9743 6664
Email: michael.li@pta.asn.au

**PROFICIENCY TESTING AUSTRALIA
BITUMEN PROFICIENCY TESTING PROGRAM
ROUND 11**

RESULTS SHEET

Lab Code

TEST (report to)	Result	MU ±	Method
Viscosity at 135.0°C (0.001 Pa.s)			
Density at 15.0C (bottle) (0.1 Kg/m ³)			
Penetration 25.0°C, 100g, 5s (0.1 mm)			
Softening Point (0.2 °C)			
Penetration Index			
Viscosity at 60.0°C (0.1 Pa.s)			

TEST (report to)	Result		MU ±	Method
	AS Oven	ASTM Oven		
Viscosity at 60.0°C after RTFO Treatment (0.1 Pa.s)				
Viscosity at 60.0°C as % of Original After RTFO treatment				
Measured RTFOT Temperature (0.1 °C)				

If rotational viscometer is used for any viscosity determination, please report make and model _____

Also please report:

i) Mean Shear rates for all viscosities tested: at 135.0°C _____ at 60.0°C _____

ii) Partial filling method or Total filling method in the determination of density at 15°C _____

iii) If Cannon-Manning viscometers or Asphalt Institute viscometers are used _____

Date of tests: _____ Signature: _____

All laboratories are asked to return the Results Sheet by 22 November 2019 to:

Dr Michael Li

Proficiency Testing Australia, PO Box 7507, Silverwater NSW 2128, AUSTRALIA

Phone +61 2 9736 8397 Fax +61 2 9743 6664 Email michael.li@pta.asn.au

- *End of Report* -