COAL CONCEPTS

SEMI-PREPARED / TOTAL MOISTURE PROFICIENCY TESTING

REPORT TWENTY EIGHT

Revision: 00

Final report

DECEMBER 2018

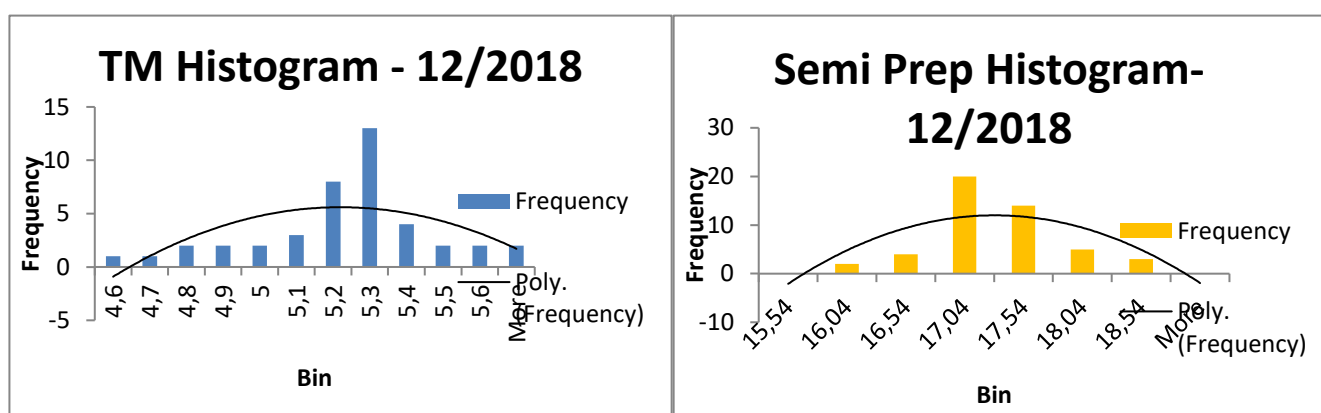| PARTICIPANT: |
|---|
| |

LABORATORY COORDINATOR: M SIBANYONI

SIGNATURE: _____

CHECKED BY: R BABOOLAL (DIRECTOR)

EXECUTIVE SUMMARY

1. Fifty samples were sent to participants with 49 result submissions.

2. There were 7 outliers observed using Grubbs estimate for total moisture. It is recommended, but not compulsory, that the lab investigates their results which are not within the reproducibility limits, which are indicated by **. Robust statistics were applied to calculate the robust standard deviation and robust average, the distribution of results did follow a Gaussian curve (below).

3. There were no outliers detected for sample preparation with Ash determination as the indicator. Robust statistics were applied to calculate the robust standard deviation and robust average, the distribution of results did follow a Gaussian curve (below)

4. The trending of z-scores over time is a good indication of the laboratory's performance.

TABLE OF CONTENTS

Dear xxx

RE: SEMI-PREPARED SAMPLE PROFICIENCY TESTING RESULTS FOR THE MONTH OF DECEMBER 2018

Thank you for your participation in the Coal Concepts proficiency testing scheme.

Your laboratory code is **xxx**

All results are totally confidential. Any results in bold, italics and underlined are outliers. Where applicable, the most extreme outliers have been eliminated from calculation of averages using the Grubbs estimate for outliers. Please take note of the following:

1. Z-scores between -1 and +1 is deemed acceptable

2. Z-scores between -2 and -3 should serve as a warning that the analysis result could get worse

3. Z-scores between +2 and +3 should also serve as a warning that analysis results could get worse.

4. Z- scores lower than -3 and exceeding +3 should warrant an investigation

6. All calculations can be made available upon request

The Coal Concepts scheme adheres to the requirements of ISO/IEC 17043:2010 – Conformity assessment – General requirements for proficiency testing.

Please find results attached together with Z-score trends.

Best Regards

R Baboolal

LIST OF PARTICIPANTS IN ALPHABETICAL ORDER

| |
|---|
| Alfred H Knight |
| ALS Witlab |
| ALS Phalanndwa |
| Bureau Veritas Inspectorate Laboratories Alton |
| Bureau Veritas Beira Laboratory |
| Bureau Veritas Inspectorate Laboratories Middelburg |
| Bureau Veritas Inspectorate Laboratories Tendele |
| Bureau Veritas Moatize Laboratory |
| Bureau Veritas Nacala Laboratory |
| Cotecna South Africa Middelburg |
| Delmas Coal |
| Eskom Holdings - Arnot Power Station |
| Eskom Holdings - Duvha Power Station |
| Eskom Holdings - Hendrina Power Station |
| Eskom Holdings - Grootvlei Power Station |
| Eskom Holdings - Kriel Power Station |
| Eskom Holdings - Lethabo Power Station |
| Eskom Holdings - Kendal Power Station |
| Eskom Holdings - Majuba Power Station |
| Eskom Holdings – Matla Power Station |
| Eskom Holdings – Tutuka Power Station |
| Exxaro Grootegeluk |
| Exxaro Matla |
| G&W Base and Industrial Minerals |
| Intertek Commodoties - Mozambique |
| Mitra SK - Richards Bay |
| Mpumamanzi |
| Noko Analytical Services |
| Ronewa Lab |
| SABS Richards Bay |
| SABS Secunda |
| SABS Springlake |
| SABS Uitkomst |
| SGS Richards Bay - Port |
| SGS GGV |
| SGS Impunzi |
| SGS Wonderfontein |
| SGS Middelburg |
| SGS Trichardt |
| SGS Tweefontein |
| SGS Leeuwpan |
| SGS RBCT Laboratory |
| Sibonisiwe Middelburg |
| Siza Coal Services Kinross |
| Siza Coal Service Botswana |
| Siza Coal Services Middelburg |
| Siza Coal Services Mooiplaats |
| Siza Coal Services Wildfontein |
| Umzamo Analytical Services - Witbank |
| Umzamo Analytical Services - Overlooked |
| Vitrovian Analytical Services |
| Zululand Anthracite Colliery |

1. **TYPE OF SAMPLE USED**

   The coal used in this proficiency testing round was bituminous coal from the Mpumalanga region.

2. **PREPARATION OF SAMPLE**

   Approximately 180kg's of sample with an approximate topsize of 50mm was sourced. This was crushed to -4.75 mm using a jaw crusher. The 4.75mm screen was placed on a 600um screen and the -4.75 mm material screened in batches of about 5kgs. Coal passing through the 4.75mm screen but retained on the 600um screen was placed in a mixing drum. Once all the coal was screened and transferred to the mixing drum, it was mixed for approximately 4 hours. The material was then transferred to containers capable of holding about 2kg of coal sample. Fifty two samples were obtained in this way.

COAL CONCEPTS - PROFICIENCY TESTING - DECEMBER 2018		
ANALYTICAL PARAMETER : TOTAL MOISTURE (%)		
LAB ID	AS RECEIVED(%)	Z-SCORE (AR)
1e	5,0	-0,69
3e	5,6	1,88
4e	4,7	-2,08
5e	5,2	0,00
7e	4,7	-1,91
9e	5,2	0,00
10e	5,1	-0,23
11e	5,0	-0,56
12e	5,2	0,00
*13e** *	*3,1*	*-8,66*
14e	4,6	-2,50
*15e** *	*9,1*	*16,64*
16e	5,2	0,00
18e	4,8	-1,49
20e	5,3	0,57
21e	5,4	1,16
23e	5,2	0,00
24e	5,2	0,00
25e	5,1	-0,10
26e	5,3	0,57
27e	5,2	0,00
29e	5,3	0,62
30e	5,1	-0,23
32e	5,2	0,00
33e	4,7	-1,91
35e	*6,7*	*6,39*
37e	5,2	0,00
38e	5,1	-0,23
39e	5,5	1,46
40e	5,2	0,00
41e	5,2	0,00
42e	5,1	-0,23
44e	5,3	0,49
45e	*4,0*	*-4,87*
46e	5,2	0,00
47e	5,0	-0,65
48e	5,1	-0,23
49e	5,4	1,04
50e	5,0	-0,65
51e	5,3	0,62
52e	*3,8*	*-5,71*
53e	5,4	0,95
55e	5,5	1,46
56e	4,9	-1,11
57e	5,3	0,62
59e	5,6	1,88
63e	*6,2*	*4,20*
*64e** *	*3,4*	*-7,40*
66e	5,0	-0,73
Number of results	-	49	-
OUTLIERS	-	7	-
AVERAGE	-	5,2	-
STD DEVIATION	-	0,2	-
MEDIAN		5,2	
MAXIMUM		5,6	
MINIMUM		4,6	
RANGE		1,0	
ROBUST AVERAGE	-	5,2	-
ROBUST STD DEVIATION	-	0,3	-
UoM		0,05	
Upper reproducibility limit		6,7	
Lower reproducibilty limit		3,7	

TM Z SCORE
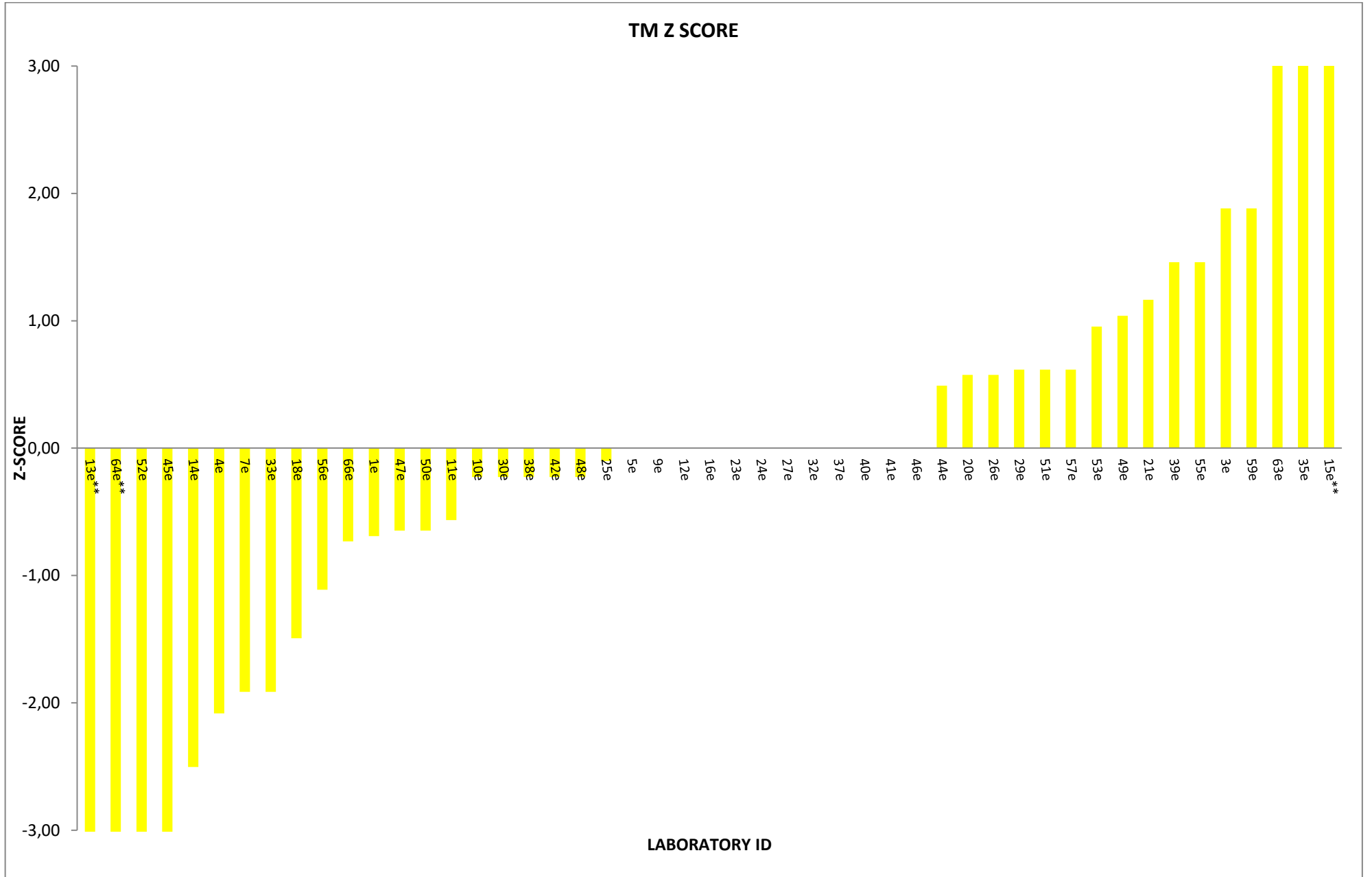
	LAB ID	MOISTURE IN ANALYSIS SAMPLE (%)	AIR DRY	DRY BASE	Z-SCORE (DRY BASE)
		COAL CONCEPTS - PROFICIENCY TESTING - DECEMBER 2018			
		ANALYTICAL PARAMETER : ISO ASH SEMI PREP PT (%)			
	1e	2,59	16,78	17,23	0,41
	3e	2,30	16,40	16,79	-0,42
	4e	1,59	16,64	16,91	-0,19
	5e	1,50	16,50	16,75	-0,48
	7e	1,90	16,90	17,23	0,41
	9e	3,30	16,50	17,06	0,10
	10e	3,80	17,40	18,09	2,01
	11e	3,07	16,31	16,83	-0,34
	12e	2,67	16,26	16,71	-0,56
	13e	3,10	16,20	16,72	-0,54
	14e	2,44	15,93	16,33	-1,27
	16e	2,10	16,55	16,91	-0,19
	18e	2,20	16,20	16,56	-0,83
	20e	2,49	16,61	17,03	0,04
	21e	2,49	16,41	16,83	-0,34
	23e	3,06	15,75	16,25	-1,42
	24e	2,89	17,17	17,67	1,24
	25e	2,14	15,21	15,54	-2,74
	26e	2,49	17,12	17,56	1,02
	27e	2,62	16,73	17,18	0,32
	29e	2,01	16,79	17,13	0,23
	32e	2,29	16,65	17,04	0,06
	33e	1,60	16,50	16,77	-0,45
	35e	2,05	16,45	16,79	-0,40
	37e	2,50	16,40	16,82	-0,35
	38e	4,10	15,60	16,27	-1,38
	39e	4,10	16,60	17,31	0,56
	40e	3,30	16,60	17,17	0,29
	41e	1,90	16,20	16,51	-0,92
	42e	2,20	16,30	16,67	-0,64
	44e	2,45	16,91	17,33	0,61
	45e	0,74	17,94	18,07	1,99
	46e	1,68	17,42	17,72	1,32
	47e	2,45	17,45	17,88	1,63
	48e	2,05	16,55	16,90	-0,21
	49e	2,25	16,86	17,25	0,45
	50e	2,04	15,52	15,84	-2,18
	51e	2,84	17,40	17,91	1,68
	52e	1,26	16,88	17,10	0,16
	53e	2,57	16,14	16,57	-0,83
	55e	2,49	16,50	16,92	-0,16
	56e	2,93	16,70	17,20	0,36
	57e	2,32	16,70	17,10	0,16
	59e	3,25	16,35	16,90	-0,20
	63e	2,62	16,55	17,00	-0,03
	64e	3,60	16,50	17,12	0,20
	65e	2,49	17,75	18,20	2,23
	66e	2,55	16,35	16,78	-0,43
NUMBER OF RESULTS	-	48	48	48	-
OUTLIERS	-	**0**	**0**	**0**	-
AVERAGE	-	**2,49**	**16,59**	**17,01**	-
STD DEVIATION	-	-	**0,53**	**0,54**	-
MEDIAN			16,55	16,96	
ROBUST AVERAGE	-	-	16,59	17,01	
ROBUST STD DEVIATION	-	-	0,55	0,56	-
UoM	-	-	0,10	0,10	-

ASH Z-SCORE
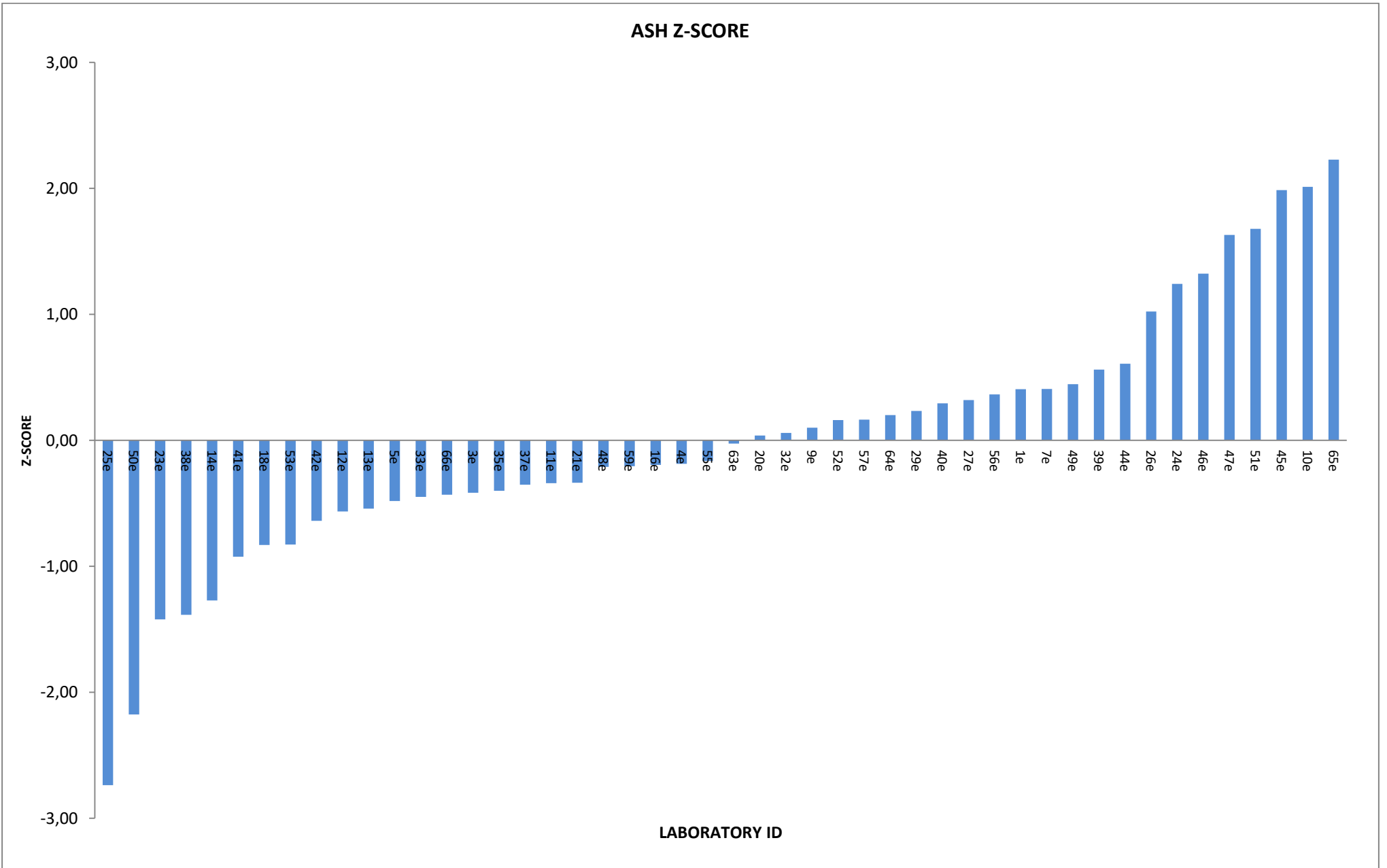
3.   **CONCLUSION**

3.1 The mean, median and robust average compare well for Total Moisture results, indicating an acceptable spread of results and that the extreme values reported did not influence the centralized results. Seven outliers were determined using Grubbs estimate, possibly due to the samples being swopped or gross errors.

3.2 The total moisture z-score trend was negatively biased, indicating generally lower values being reported.

3.3 The spread of results for sample preparation is acceptable with mean, median and robust average being the similar. No outliers were observed.

3.4 The z-score trend had almost equal negative and positive z scores.

3.5 Homogeneity:

SAMPLE NO.	Test portion 1	Test portion 2	sample av (Xt)	range (Wt)	range sqd
1	16,25	16,46	16,36	0,21	0,0441
2	16,51	16,47	16,49	0,04	0,0016
3	16,60	16,30	16,45	0,30	0,0900
4	16,43	16,51	16,47	0,08	0,0064
5	16,25	16,57	16,41	0,32	0,1024
6	16,36	16,66	16,51	0,30	0,0900
7	16,59	16,75	16,67	0,16	0,0256
8	16,61	16,70	16,66	0,09	0,0081
9	16,53	16,29	16,41	0,24	0,0576
10	16,74	16,46	16,60	0,28	0,078
GENERAL AVERAGE				16,50	
STANDARD DEVIATION				0,11	
WITHIN SAMPLE STANDARD DEVIATION				0,159	
BETWEEN SAMPLE STANDARD DEVIATION				0,033	

The between sample standard deviation must be ≤ 0.3 x σ̒
(σ̒ = std deviation for the proficiency assessment)

σ̒ = 0.495 was used, which is the repeatability for ISO ash.
Hence 0.3 x 0.495 = 0.149

Since 0.033 is less than 0.149the samples are homogenous

End of Report

COAL CONCEPTS: Terms and Conditions

Return of results:

Laboratories participate in proficiency testing programs on the understanding that they will be sharing their results and information **anonymously** with other laboratories performing the same analysis. No return of results compromises the spirit of the programs, and reports will not be sent to laboratories unless they return results. Payment in full is required from all laboratories enrolling whether they return results or not.

Errors in Participant Proficiency Testing Results:

Proficiency testing reports should reflect the level of accuracy that a regular testing client would receive.

If a participant finds an error in their proficiency testing results, they may notify us in writing and change their submission **PRIOR** to the due date for return. Changes after this time will not be accepted.

Coal Concepts' reports results *as submitted* by participants.

On occasion, it seems as though participants have mixed up the samples or not processed the samples according to the instructions. Coal Concepts cannot make assumptions of this nature and change results 'to suit'. We also cannot compromise the integrity of the programs by suggesting to some participants that they should review their results prior to the due date. (This is unfair to other participants) It is the responsibility of the participants to check all aspects of the program, including sample identification, preparation, testing instructions, calculations and reporting of the results prior to results submission.

If samples are not in good condition on arrival to the participant laboratory, Coal Concepts must be notified in writing IMMEDIATELY, as often samples can be replaced in good time. Claims about samples received in bad condition will not be accepted after the report has been issued.

Late Enrolments and Late Results:

Late enrolment requests cannot always be accommodated, as sample manufacture must be scheduled well in advance to the shipping date of the program to allow all necessary quality assurance activities to be carried out.

Shipping of PT materials and evaluating test results from PTPs out of cycle with the mainstream programs is considerably time consuming and therefore costly. In order not to disadvantage participants able to comply with time frames, Coal Concepts may charge a late fee in the following circumstances:

Requests that Coal concepts staff enters results on behalf of participants

Requests to record results after the due date

Requests for PTP participation that is out of cycle with the scheduled dates

Shipping fees and Customs clearance:

Costs incurred for shipping samples and clearance of same through customs are the responsibility of the participating laboratory unless otherwise indicated

Non-payment of fees:

Coal Concepts retains the right to withhold reports and/or test materials and services when invoices are outstanding.

Confidentiality of results:

All data and information received by Coal Concepts from its clients are considered confidential unless the client has given express permission to pass on information.

Definitions:

The dictionary definitions of "collusion" and "falsification" are as follows.

· *Collusion:* A secret agreement or cooperation for a fraudulent or

deceitful purpose.

· *Falsification:* Deliberately changing something to be false. In proficiency testing terms, collusion is comparing data (and perhaps changing data) to fit in with a believed "correct" result. This is contrary to the spirit of proficiency testing programs, which are issued with the intention of providing an objective comparison of a laboratory's performance with others. Coal Concepts tries to minimise the occurrence of collusion by being aware that laboratories should be objective when they report their results, and should therefore not know the intended results at the time they are reporting to us.

Answers are not provided to clients until results have been submitted.

To prevent collusion and falsification our advice to clients is:

DON'T confer with others about PT samples or results.

DO accept the fact that everyone makes errors.

DON'T average the results or opinions of every person in the laboratory before selecting the answer to be submitted. Instead, use one of the answers AS SUBMITTED to you and take advantage of the Coal Concepts internal QA services and submit all answers generated by the technicians.

DO have confidence in your own results.

Proficiency Testing (PT) is a compulsory part of laboratory accreditation, but it is also an important tool for giving you confidence in your results. "Enhancing" your PT results with assistance from another participant cannot increase confidence in your laboratory's performance.

Coal concepts' testing staff are not told what the expected results are, nor what we are expecting.

We subject ALL results to analysis, even if they are different.

The staff have the right to check that the results we enter on their behalf are correctly transcribed.

Clients are always welcome to contact Coal Concepts to seek advice or information about collusion or falsification of data.

Policy for Participant Appeal of PT Performance Assessment:

If participants disagree with their performance assessment in a proficiency report, they should inform Coal Concepts in writing.

The response will include Coal Concepts interpretation of the outcome of the reassessment and an explanation of that outcome. (For example, explanation of a calculation, or the rationale for the outcome of the evaluation.)

If a mistake has been made by Coal Concepts, it will be dealt with via Coal Concepts' non-conformance system.

Liability

In no event shall a party's liability to the other party for direct damages exceed an amount equal to the value of the amount for the PT Programme, under that specific month