



AZURESKY PTY LTD PROFICIENCY TESTING

GENERAL ANALYSIS REPORT

LABORATORY CODE:

Final Report

Report No: 4

Date Issued: 01st August 2025

Document compiled by:

Laboratory Manager - Sifiso Nyambi

Signature:

Document authorised by:

Managing Director - Nonhlanhla Msibi

Signature:

1. Letter to participant

- Azuresky (Pty) Ltd would like to express gratitude that LAB NAME participated in this round of the proficiency testing scheme.
- Each participant is allocated a random unique number for the programme to enable total confidentiality of results.
- The unique identification number for your laboratory is LAB NUMBER

Participants are encouraged to submit any comments and queries regarding results or the operation of the scheme to email: info@azuresky.it.com or nonhlanhla@azuresky.it.com.

2. Executive summary

Azuresky Pty Ltd is a proficiency testing scheme provider and certified reference material producer. We aim to produce a homogenous proficiency test sample and stable certified reference material to be used for the evaluation of participant performance against pre-defined criteria in interlaboratory comparison programs specific to coal testing methods and calibration of coal testing equipment.

The source of the coal samples for this round was acquired from a mine located in Mpumalanga, and the coal type is bituminous.

The identity of PT samples dispatched for this round is, “ Proficiency Testing Sample A July 2025”.

Total number of participants for this round was 36.

When the sample size is sufficiently large, the sampling distribution of the sample mean approaches a normal distribution, regardless of the shape of the original population distribution. This assumption underpins all statistical analyses and calculations presented in this report.

There are two outliers identified within this report, one for calorific value analysis and the other for quick ash analysis.

For meaningful statistical evaluation, a minimum sample size of $n = 10$ is required. As the sample size for Ash Fusion Temperature (AFT), Total Carbon, and Hydrogen is less than 10, only indicative values on an air-dry basis are presented for these parameters.

Interpretation of trends necessitates a minimum of five data points to ensure meaningful analysis, while graphical representation requires at least two data points to establish a visual comparison.

3. List of participants

No	Participants
1	Best Enough Laboratory Services NCC
2	Mfulawamanzi Kleinfontein
3	Noko Analytical Services Piet Retief
4	Siza Labs NBC
5	Siza Labs Kinross
6	Siza labs Matsambisa
7	Bestech Diepsruit Collieries
8	SA Lab Middelburg
9	Cotecna Middelburg
10	Noko Analytical Services Witbank
11	Siza Labs Mgayo
12	Siza Labs Leeuwpan
13	Umzamo Laboratory Services Dorinda
14	Umzamo Laboratory Services Main lab
15	Siza Labs Dundee
16	Siza Middelburg
17	Sibonisiwe Coal Laboratory Services RMC
18	Sibonisiwe Coal Laboratory Services Main Lab
19	Sibonisiwe Coal Laboratory Services Clewer
20	Siza Labs Umlalazi
21	Ronewa Gugulethu
22	Ronewa Wescoal
23	Bestech Zomhlaba Lakeside
24	Siza Labs Sasolburg
25	Mfulawamanzi Piet Retief
26	Ronewa Main Lab

No	Participants
27	PJS Middelburg Lab
28	PJS Salaria Lab
29	Best Enough Lab (TNC/2 Seam)
30	SABS Secunda
31	SGS-South Africa (Pty) Ltd Commercial Laboratory Richards Bay
32	Best Enough Laboratory Services Commercial Lab
33	Bureau Veritas Inspectorate Laboratory
34	Imbally (Pty) Ltd Main Laboratory
35	Umzamo Analytical Services Botswana
36	Umzamo Analytical Services Hendrina

4. Homogeneity check

10 random samples were extracted from the batch during packaging. These were used for homogeneity assessment before distribution of samples to participants.

	Air-dry basis				
# Sample	%R1	%R2	%Sample av (Xt)	Range (Wt)	Range sqd
1	31.54	31.64	31.59	0.1	0.0100
2	32.17	32.17	32.17	0	0.0000
3	32.12	31.72	31.92	0.4	0.1600
4	32.08	32.35	32.22	0.27	0.0729
5	32.45	32.95	32.70	0.5	0.2500
6	32.92	32.62	32.77	0.3	0.0900
7	32.85	32.67	32.76	0.18	0.0324
8	32.71	32.95	32.83	0.24	0.0576
9	32.80	32.97	32.89	0.17	0.0289
10	32.42	32.81	32.62	0.39	0.1521
Overall Average			32.45		
Standard Deviation			0.46		
SSwithin			3.947		
SSbetween			0.0312		
opt			9.244		
Check value			2.773		
where: $\bar{o}pt$ is the standard deviation from the pt					
Conclusion : Since $SS_{between} < Check\ value$. Thus, homogeneity is sufficient.					

5. Stability check

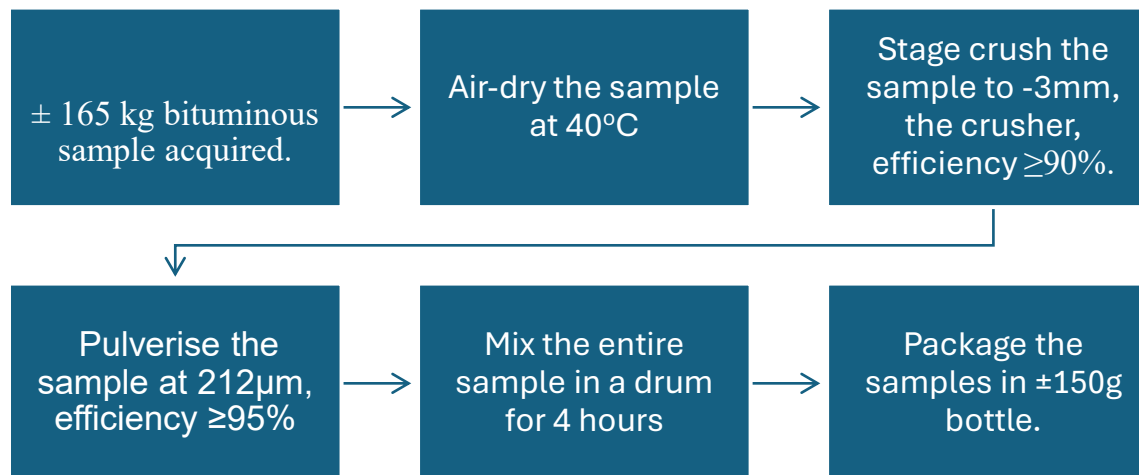
# Sample	%R1	%R2	Sample av (Xt)	Range (Wt)	Range sqd
1	32.93	32.95	32.94	0.02	0.0004
2	33.03	32.95	32.99	0.08	0.0064
3	32.74	32.82	32.78	0.08	0.0064
4	32.78	32.6	32.69	0.18	0.0324
5	32.72	32.57	32.645	0.15	0.0225
6	32.68	32.49	32.585	0.19	0.0361
7	32.63	32.45	32.54	0.18	0.0324
8	32.41	32.08	32.245	0.33	0.1089
9	32.15	32.16	32.155	0.01	1E-04
10	32.29	32.13	32.21	0.16	0.0256
Overall Average			32.58		
Standard Deviation			0.30		
SSwithin			1.639		
SSbetween			0.067		
Check value from the homogeneity assessment is 2.773 The mean difference between homogeneity and stability assessments is (32.58-32.45 = 0.1325) Since 0.1325<2.773, the PT samples meet stability requirements					

6. Sample preparation

The sample preparation procedure was conducted in accordance with the guidelines outlined in ISO 13909-4, ISO/IEC 17025, ISO/IEC 17043, and ISO 17034. Prior to the distribution of samples, ten random sub-samples of approximately 150 grams each were drawn using the flat-and-heap method from the 600 grams obtained from the homogeneity drum.

None of the activities for the PT program were subcontracted.

Sample preparation process flow:



7. Measurement Protocol and identification of the measurement standard

The analysis performed for this round together with the SI units are stipulated below:

- Calorific Value measured in MJ/Kg
- ISO Ash in % m/m
- Quick Ash in % m/m
- Total Sulphur %
- Moisture in Analysis sample % m/m
- Ash Fusion Temperature (°C)

8. Measurement Results

Lab ID	AIR DRY BASIS						ASH FUSION TEMPERATURE (oC)				%Hydrogen	%Total Carbon
	%Moisture	%Quick Ash	% ISO Ash	% ISO Volatile	Calorific Value MJ/Kg	%Total Sulphur	DT	ST	HT	FT		
1	3.7	33.3	***	***	18.55	1.14	***	***	***	***	***	***
2	5.2	32.8	32.7	21.4	18.39	***	***	***	***	***	***	***
4	4.3	33.0	32.9	22.2	18.82	1.05	***	***	***	***	***	***
5	3.0	33.1	33.4	22.7	18.90	1.09	***	***	***	***	***	***
6	4.5	33.0	32.5	22.5	19.58	1.13	1410	1430	1460	1480	***	***
7	3.9	33.0	33.2	22.2	19.17	1.11	***	***	***	***	***	***
8	4.6	32.7	***	22.1	19.35	***	***	***	***	***	***	***
10	4.1	***	33.2	22.7	18.35	***	***	***	***	***	***	***
11	4.7	***	32.1	21.8	18.43	1.02	***	***	***	***	***	***
12	4.2	***	32.3	22.6	18.77	1.07	***	***	***	***	***	***
15	4.4	***	32.9	22.0	19.06	1.10	***	***	***	***	***	***
17	3.7	***	32.5	21.9	18.98	1.13	***	***	***	***	***	***
18	3.6	***	33.3	21.9	18.82	1.01	1375	1405	1450	1480	***	***
19	3.5	***	33.4	22.3	18.84	0.99	1380	1410	1450	1480	***	48.4
20	3.5	***	33.2	22.3	19.27	1.09	***	***	***	***	***	***
25	3.8	33.0	33.3	22.4	19.40	1.13	***	***	***	***	***	***
27	4.5	32.1	***	22.2	18.72	1.19	***	***	***	***	***	***
28	4.3	***	32.7	22.1	18.66	1.12	1400	1420	1450	1480	***	***
29	4.3	32.8	***	22.9	18.75	0.97	***	***	***	***	***	***
34	4.7	32.7	32.7	22.8	18.82	1.02	***	***	***	***	***	***
35	3.5	33.2	***	22.2	18.84	1.08	***	***	***	***	***	***
36	4.3	33.0	***	21.6	18.41	1.13	***	***	***	***	***	***
44	4.8	32.6	***	22.1	19.40	***	***	***	***	***	***	***
47	3.3	33.2	***	22.8	19.08	1.17	***	***	***	***	***	***
49	4.8	32.8	32.8	22.6	18.92	***	***	***	***	***	***	***

Lab ID	AIR DRY BASIS						ASH FUSION TEMPERATURE (oC)				%Hydrogen	%Total Carbon
	%Moisture	%Quick Ash	% ISO Ash	% ISO Volatile	Calorific Value MJ/Kg	%Total Sulphur	DT	ST	HT	FT		
50	3.6	33.2	32.7	21.9	18.45	1.09	1480	1490	1500	1500	***	***
51	4.7	32.6	***	21.3	18.81	1.14	***	***	***	***	***	***
52	4.9	32.5	***	21.2	18.81	***	***	***	***	***	***	***
57	4.8	32.5	***	22.0	20.20	***	***	***	***	***	***	***
59	3.90	***	32.20	22.30	18.81	1.06	1410	1430	1450	1470	2.3	47.0
60	4.98	32.50	32.50	20.90	18.61	1.06	1350	1400	1410	1430	2.6	48.4
61	4.40	***	32.20	22.10	18.72	1.04	***	***	***	***	***	***
62	5.30	***	31.98	21.32	18.60	1.13	***	***	***	***	2.9	48.1
63	4.33	32.70	32.90	22.10	18.86	1.11	***	***	***	***	***	***
64	3.40	***	33.30	22.40	18.84	0.97	***	***	***	***	***	***
65	3.60	***	33.50	21.60	18.83	0.98	***	***	***	***	***	***

Key: “ *** “represents no participation

	Dry-base										
Lab ID	% ISO Moisture	% Quick Ash	Z-score	% ISO Ash	Z-score	%Volatile	Z-score	Calorific Value (MJ/Kg)	Z-score	%Total Sulphur	Z-score
1	3.7	34.6	1.55	***	***	***	***	19.26	-1.27	1.18	0.91
2	5.2	34.6	1.88	34.5	0.73	22.6	-1.09	19.40	-0.85	***	***
4	4.3	34.4	0.67	34.3	0.25	23.2	0.27	19.66	-0.04	1.10	-0.46
5	3.0	34.1	-1.46	34.4	0.56	23.4	0.75	19.48	-0.58	1.12	-0.03
6	4.5	34.6	1.57	34.0	-0.56	23.6	1.10	20.50	2.62	1.18	0.90
7	3.9	34.3	0.05	34.5	0.88	23.1	0.08	19.95	0.88	1.16	0.46
8	4.6	34.3	-0.39	***	***	23.2	0.22	20.28	1.93	***	***
10	4.1	***	***	34.6	1.05	23.6	1.24	19.14	-1.66	***	***
11	4.7	***	***	33.7	-1.53	22.9	-0.42	19.34	-1.04	1.07	-0.87
12	4.2	***	***	33.7	-1.44	23.6	1.17	19.59	-0.24	1.12	-0.14
15	4.4	***	***	34.4	0.51	23.0	-0.12	19.94	0.84	1.15	0.39
17	3.7	***	***	33.7	-1.35	22.8	-0.67	19.71	0.13	1.17	0.74
18	3.6	***	***	34.5	0.87	22.7	-0.77	19.52	-0.46	1.05	-1.22
19	3.5	***	***	34.6	1.06	23.1	0.10	19.52	-0.46	1.03	-1.56
20	3.5	***	***	34.4	0.48	23.1	0.10	19.97	0.94	1.13	0.06
25	3.8	34.3	-0.20	34.6	1.07	23.3	0.49	20.17	1.56	1.17	0.76
27	4.5	33.6	-5.06	***	***	23.2	0.40	19.60	-0.21	1.25	1.88
28	4.3	***	***	34.2	-0.18	23.1	0.06	19.50	-0.54	1.17	0.69
29	4.3	34.3	-0.51	***	***	23.9	1.89	19.58	-0.27	1.01	-1.76
34	4.7	34.3	-0.13	34.3	0.22	23.9	1.91	19.75	0.25	1.07	-0.87
35	3.5	34.4	0.32	***	***	23.0	-0.16	19.53	-0.43	1.12	-0.10
36	4.3	34.5	1.06	***	***	22.6	-1.10	19.24	-1.36	1.18	0.86
44	4.8	34.2	-0.62	***	***	23.2	0.33	20.38	2.23	***	***
47	3.3	34.3	0.01	***	***	23.5	1.07	19.73	0.20	1.21	1.31
49	4.8	34.5	0.86	34.5	0.65	23.7	1.45	19.87	0.64	***	***
50	3.6	34.4	0.66	33.9	-0.91	22.7	-0.83	19.14	-1.65	1.13	0.08
51	4.7	34.2	-0.87	***	***	22.4	-1.58	19.74	0.22	1.20	1.10
52	4.9	34.2	-1.11	***	***	22.3	-1.71	19.78	0.35	***	***
57	4.8	34.1	-1.36	***	***	23.1	0.10	21.22	4.87	***	***

	Dry-base										
Lab ID	% ISO Moisture	% Quick Ash	Z-score	% ISO Ash	Z-score	%Volatile	Z-score	Calorific Value (MJ/Kg)	Z-score	%Total Sulphur	Z-score
59	3.9	***	***	33.5	-2.02	23.2	0.31	19.57	-0.30	1.10	-0.36
60	5.0	34.2	-0.90	34.2	-0.08	22.0	-2.37	19.59	-0.26	1.12	-0.16
61	4.4	***	***	33.7	-1.53	23.1	0.12	19.58	-0.27	1.09	-0.59
62	5.3	***	***	33.8	-1.29	22.5	-1.22	19.64	-0.09	1.19	1.05
63	4.3	34.2	-1.07	34.4	0.44	23.1	0.08	19.71	0.14	1.16	0.54
64	3.4	***	***	34.5	0.67	23.2	0.27	19.50	-0.52	1.00	-1.90
65	3.6	***	***	34.8	1.45	22.4	-1.46	19.53	-0.43	1.02	-1.71
# of participants	-	36	22	-	25	-	35	-	36	-	29
Outliers	-	0	1	-	0	-	0	-	1	-	0
# of participants after outlier elimination	-	36	21	-	25	-	35	-	35	-	29
Average	-	4.20	34.33	-	34.23	-	23.06	-	19.67	-	1.13
Standard deviation	-	0.58	0.14	-	0.36	-	0.45	-	0.32	-	0.06
%RSD	-	-	0.41	-	1.05	-	1.96	-	1.62	-	5.69
Median	-	-	34.31	-	34.32	-	23.11	-	19.60	-	1.13
UoM	-	-	0.03	-	0.07	-	0.08	-	0.05	-	0.01
Min	-	-	33.61	-	33.51	-	22.00	-	19.14	-	1.00
Max	-	-	34.60	-	34.75	-	23.92	-	21.22	-	1.25
standard error	-	-	0.06	-	0.16	-	0.15	-	0.11	-	0.02
Lower confidence limit	-	-	34.27	-	34.07	-	22.91	-	19.56	-	1.10
Upper confidence limit	-	-	34.40	-	34.39	-	23.22	-	19.78	-	1.15
Lower confidence limit 3x SE	-	-	34.14	-	33.75	-	22.60	-	19.34	-	1.05
Upper confidence limit 3x SE	-	-	34.53	-	34.72	-	23.53	-	20.00	-	1.20

9. Evaluation of the measurement results

- Outliers
 - Quick ash x1 (see dry base table for z-scores)
 - Calorific Value x1 (see dry base table for z-scores)
- All results are accepted as correct and cannot be changed after the release of the report.

Z-Score Evaluation Criteria:

- A z-score within the range of **±1** is considered **acceptable**.
- A z-score within the range of **±2** is regarded as **satisfactory**.
- A z-score between **±2 and ±3** is classified as **questionable**, indicating potential issues that warrant further investigation.
- A z-score exceeding **±3** is deemed **unsatisfactory** and is treated as an **outlier**

Figure 1: Volatile matter z-scores

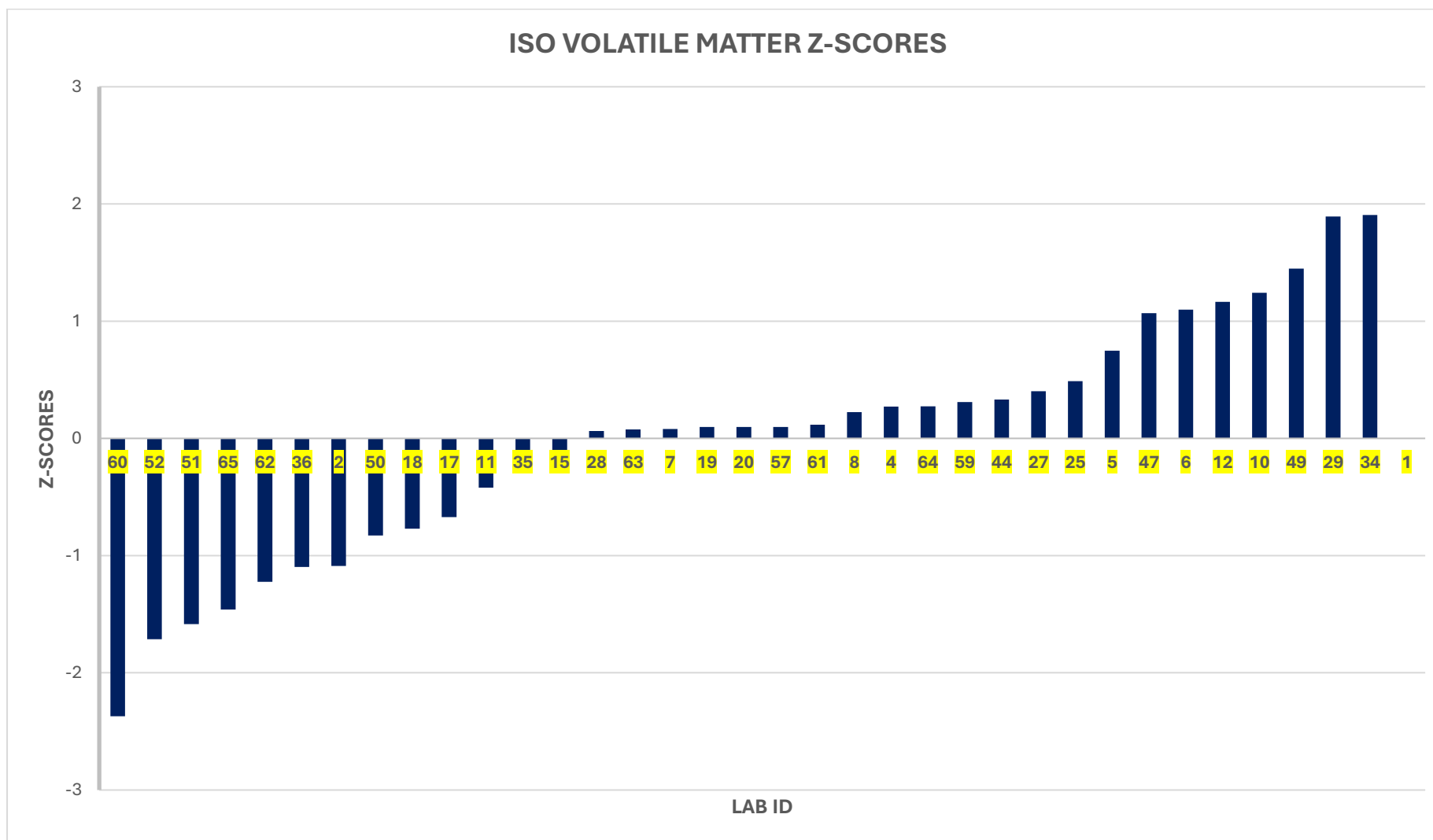


figure 2: ISO ash z-scores

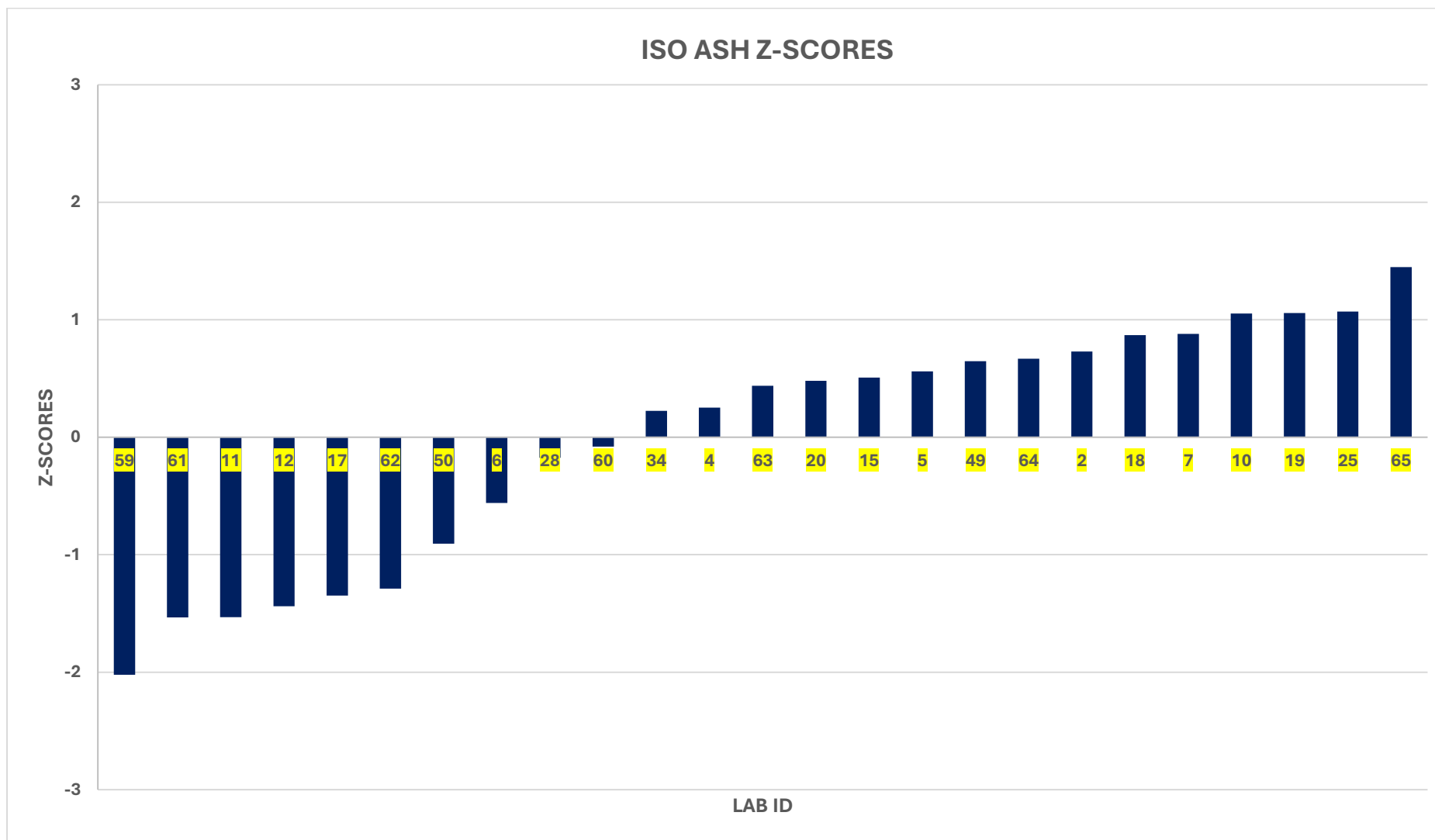


figure 3: Quick Ash z-scores

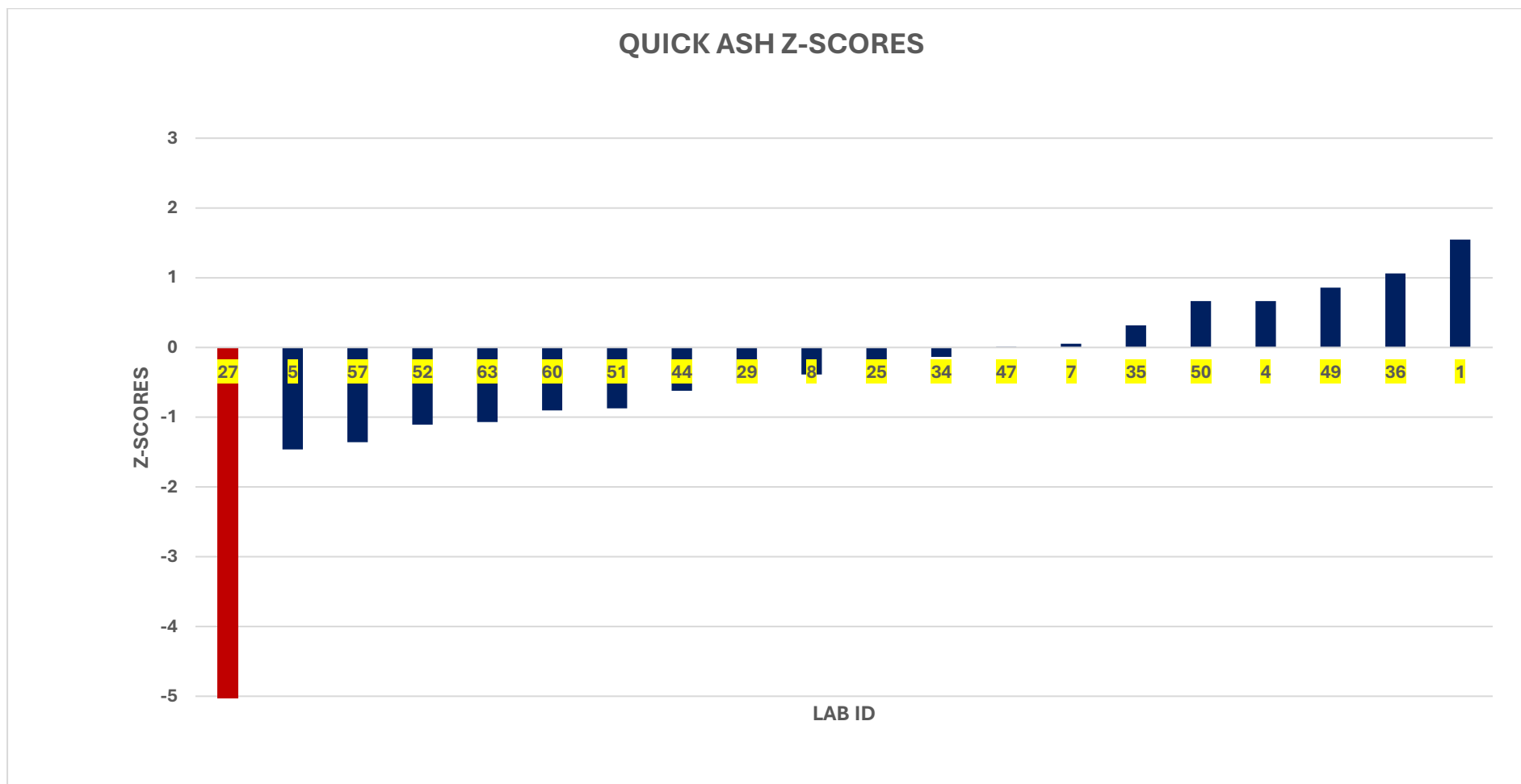


Figure 4: Calorific Value z-scores

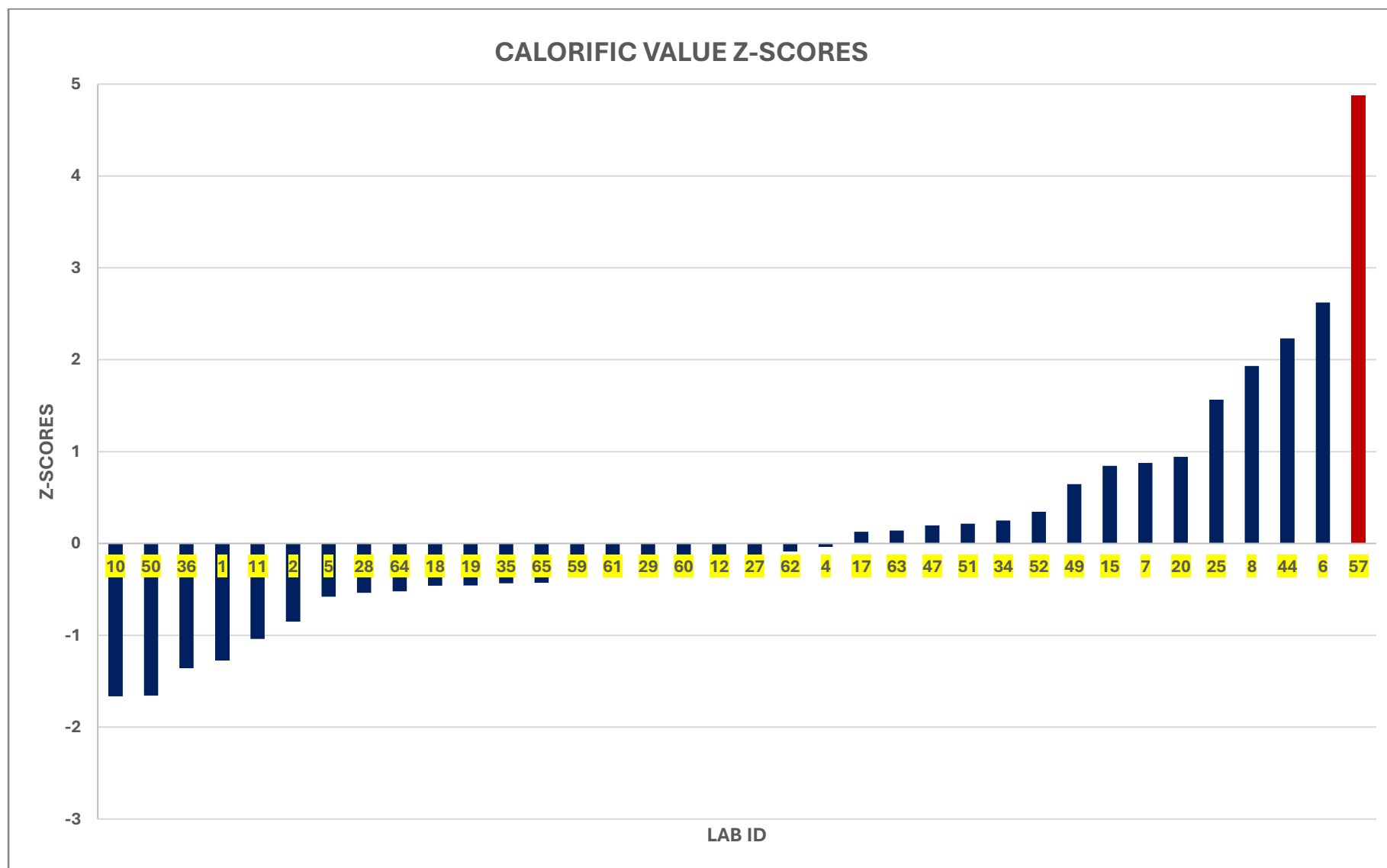
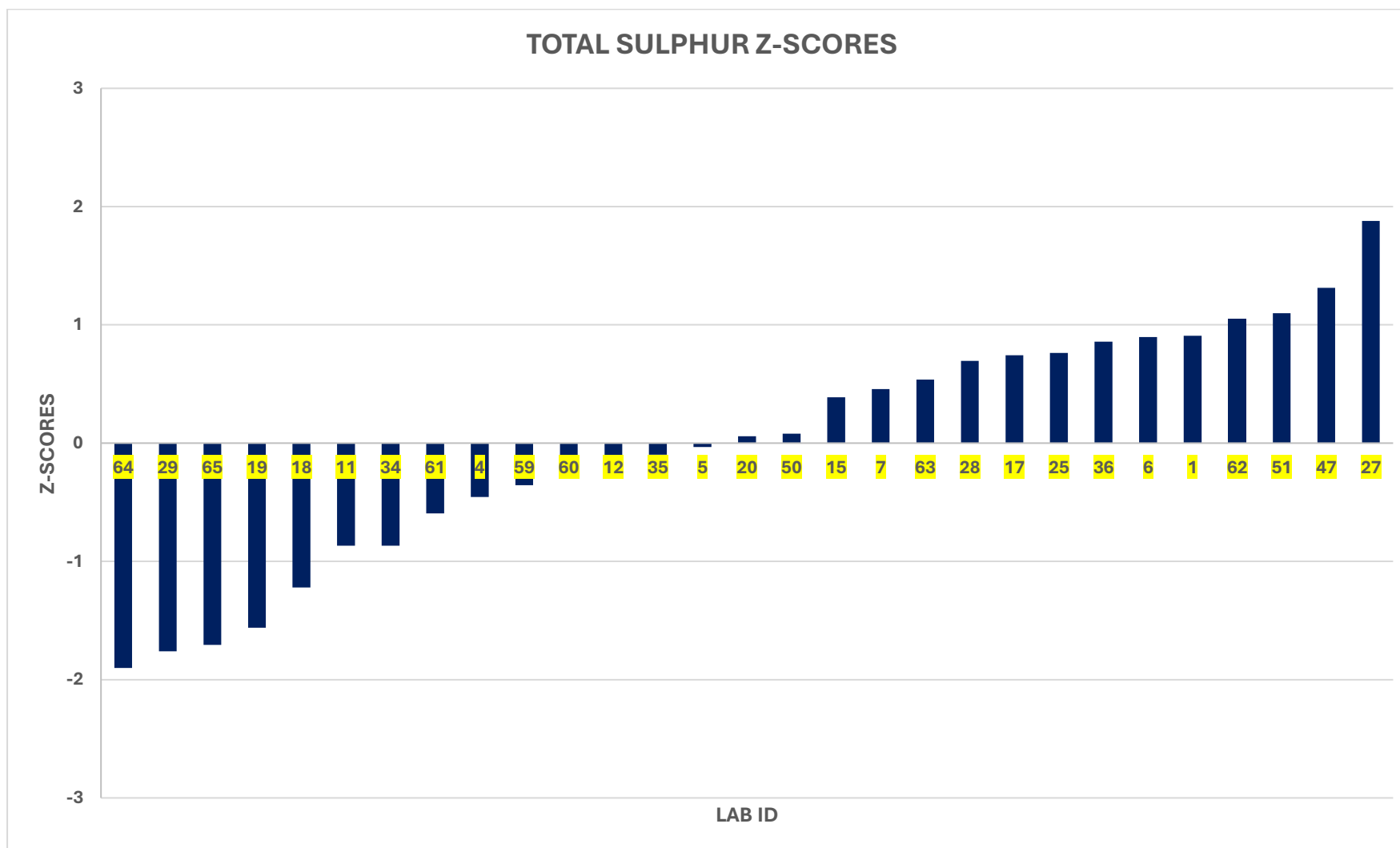


Figure 5: Total Sulphur z-scores



10. General Conclusions

- 10.1. One participant (Lab ID 27) submitted a significantly deviating result and has been excluded. After removing the outlier, the remaining 21 results align well with the average (34.33%) and show a very low %RSD of 0.41%, confirming high consistency and precision in this parameter.
- 10.2. No outliers were detected for volatile matter. The results span a narrow z-score range with a %RSD of 1.96%, which is within a reasonable threshold for this parameter. This reflects acceptable inter-laboratory consistency.
- 10.3. All reported z-scores lie within the acceptable threshold. The results show a relatively low %RSD (1.05%), supporting good agreement among the participating labs. This implies that ISO Ash values are consistent and statistically reliable.
- 10.4. One laboratory (Lab ID 57) reported a calorific value significantly higher than the rest and has been excluded. After removing this outlier, the remaining 35 values display an acceptable %RSD (1.62%) and fall within the confidence limits, indicating good comparability of results.
- 10.5. All z-scores for total sulphur are within acceptable bounds. The %RSD of 5.69% is relatively higher compared to other parameters, which may be attributed to the typically low concentrations of sulphur and corresponding sensitivity. However, no values exceed the outlier threshold, suggesting satisfactory performance overall.