

Measurement System Analysis Report (Variable Analysis)

Date: 27/08/2021

Revision.: 1.8

Approved	Prepared
	
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Measurement Device: Optical Emission Spectrometer	Department Incharge: QA/QC Dept.
Control No.: OE1204QC27	Manufacturing No: 74XCA4 (Batch A)
Model: LAVX-9	Characteristics: Pb Content, %
The number of operator: 3	Part No./ Name: MBH Standard
Technician: Hawari Elias	The Number of Sample: 1

Analysis Result

Bias • Repeatability • Reproducibility • Stability • Linearity • Other ()

Range methods, Average range method, ANOVA and GRR, acceptance criteria shall be as follows:

	Result	Decision
Repeatability & Reproducibility (%R&R)	8.37	Pass / Fail
Repeatability – variation by machine (%EV)	8.37	
Reproducibility – variation by operator (%AV)	0.00	
Variation by part (% PV)	99.65	
ndc	16	Pass / Fail

		Decision
$\leq 10\%$ error ndc ≥ 5	Generally considered to be an acceptable measurement system	Pass
11% to 30% error ndc ≥ 5	If $11\% \leq \text{GR\&R} < 30\%$ error occurs, GR & R maybe accepted based on the application of a waiver from customer.	Pass Fail
Over 30% ndc < 5	Considered to be not acceptable. Every effort should be made to improve the measurement system.	Fail

Acceptance criteria for bias, stability and linearity shall be as follows:

Bias	Zero shall fall within the confidence interval of bias	Pass Fail
Stability	$\bar{X}$ -R, $\bar{X}$ -s, X-MR Control chart: In control * Out of control	Pass Fail
Linearity	Shall select A or B below: A: "y=0" line must lie entirely within the 95% confidence bands of the regression line B: Calculated slope must be smaller than degrees of freedom as default $\alpha=0.05$ or critical value obtained from occurrence rate table	Pass Fail

Remark on decision

Following above, the acceptance that is "y=0" line must lie entirely within the 95% confidence bands of the regression line.

GAGE REPEATABILITY AND REPRODUCIBILITY DATA COLLECTION SHEET

No.	Operator	Pb Content (%)	MBH Std.
1	HAZIQ	0.0619	1
2	HAZIQ	0.0620	2
3	HAZIQ	0.0618	3
4	HAZIQ	0.0620	4
5	HAZIQ	0.0621	5
6	HAZIQ	0.0620	6
7	HAZIQ	0.0621	7
8	HAZIQ	0.0620	8
9	HAZIQ	0.0622	9
10	HAZIQ	0.0622	10
11	HAZIQ	0.0619	1
12	HAZIQ	0.0620	2
13	HAZIQ	0.0618	3
14	HAZIQ	0.0620	4
15	HAZIQ	0.0621	5
16	HAZIQ	0.0620	6
17	HAZIQ	0.0621	7
18	HAZIQ	0.0620	8
19	HAZIQ	0.0622	9
20	HAZIQ	0.0622	10
21	HAZIQ	0.0619	1
22	HAZIQ	0.0620	2
23	HAZIQ	0.0618	3
24	HAZIQ	0.0620	4
25	HAZIQ	0.0621	5
26	HAZIQ	0.0620	6
27	HAZIQ	0.0621	7
28	HAZIQ	0.0620	8
29	HAZIQ	0.0622	9
30	HAZIQ	0.0622	10
31	HAWARI	0.0619	1
32	HAWARI	0.0620	2
33	HAWARI	0.0618	3
34	HAWARI	0.0620	4
35	HAWARI	0.0621	5
36	HAWARI	0.0620	6
37	HAWARI	0.0621	7
38	HAWARI	0.0620	8
39	HAWARI	0.0622	9
40	HAWARI	0.0622	10
41	HAWARI	0.0619	1
42	HAWARI	0.0620	2
43	HAWARI	0.0618	3
44	HAWARI	0.0620	4
45	HAWARI	0.0621	5

No.	Operator	Pb Content (%)	MBH Std.
46	HAWARI	0.0620	6
47	HAWARI	0.0621	7
48	HAWARI	0.0619	8
49	HAWARI	0.0622	9
50	HAWARI	0.0622	10
51	HAWARI	0.0619	1
52	HAWARI	0.0620	2
53	HAWARI	0.0618	3
54	HAWARI	0.0620	4
55	HAWARI	0.0621	5
56	HAWARI	0.0620	6
57	HAWARI	0.0621	7
58	HAWARI	0.0620	8
59	HAWARI	0.0622	9
60	HAWARI	0.0622	10
61	ZAKI	0.0619	1
62	ZAKI	0.0620	2
63	ZAKI	0.0618	3
64	ZAKI	0.0620	4
65	ZAKI	0.0621	5
66	ZAKI	0.0620	6
67	ZAKI	0.0621	7
68	ZAKI	0.0620	8
69	ZAKI	0.0622	9
70	ZAKI	0.0622	10
71	ZAKI	0.0619	1
72	ZAKI	0.0620	2
73	ZAKI	0.0618	3
74	ZAKI	0.0620	4
75	ZAKI	0.0621	5
76	ZAKI	0.0620	6
77	ZAKI	0.0621	7
78	ZAKI	0.0620	8
79	ZAKI	0.0622	9
80	ZAKI	0.0622	10
81	ZAKI	0.0619	1
82	ZAKI	0.0620	2
83	ZAKI	0.0618	3
84	ZAKI	0.0620	4
85	ZAKI	0.0621	5
86	ZAKI	0.0620	6
87	ZAKI	0.0621	7
88	ZAKI	0.0620	8
89	ZAKI	0.0622	9
90	ZAKI	0.0622	10

GAUGE R&R STUDY (CROSSED) USING ANOVA METHOD

1.0 DATA COLLECTION

Operator: Haziq, Hawari & Zaki

Each operator measured 30 of Pb% readings. All 90 readings came from one MBH Standard sample (74XCA4).

Gauge Repeatability and Reproducibility Data Collection Sheet										
Appraiser/ Trial #	Part: MBH Std. (74XCA4 – Batch A)									
	1	2	3	4	5	6	7	8	9	10
A 1	0.0619	0.0620	0.0618	0.0620	0.0621	0.0620	0.0621	0.0620	0.0622	0.0622
2	0.0619	0.0620	0.0618	0.0620	0.0621	0.0620	0.0621	0.0620	0.0622	0.0622
3	0.0619	0.0620	0.0618	0.0620	0.0621	0.0620	0.0621	0.0620	0.0622	0.0622
B 1	0.0619	0.0620	0.0618	0.0620	0.0621	0.0620	0.0621	0.0620	0.0622	0.0622
2	0.0619	0.0620	0.0618	0.0620	0.0621	0.0620	0.0621	0.0619	0.0622	0.0622
3	0.0619	0.0620	0.0618	0.0620	0.0621	0.0620	0.0621	0.0620	0.0622	0.0622
C 1	0.0619	0.0620	0.0618	0.0620	0.0621	0.0620	0.0621	0.0620	0.0622	0.0622
2	0.0619	0.0620	0.0618	0.0620	0.0621	0.0620	0.0621	0.0620	0.0622	0.0622
3	0.0619	0.0620	0.0618	0.0620	0.0621	0.0620	0.0621	0.0620	0.0622	0.0622

Form SOP8.16-1-1.1

Remark:

Operator A: Haziq , Operator B: Hawari , Operator C: Zaki

Gage R&R Study - ANOVA Method

Gage R&R for Pb%

Gage name: VISCOMETER
Date of study: 27/08/2021
Reported by: AINI SYAREENA BT. YUSOFF
Tolerance: 0.0004
Misc:

Two-Way ANOVA Table With Interaction

Source	DF	SS	MS	F	P
MBH Std.	9	0.0000013	0.0000001	1276	0.000
Operator	2	0.0000000	0.0000000	1	0.387
MBH Std. * Operator	18	0.0000000	0.0000000	1	0.473
Repeatability	60	0.0000000	0.0000000		
Total	89	0.0000013			

α to remove interaction term = 0.05

Two-Way ANOVA Table Without Interaction

Source	DF	SS	MS	F	P
MBH Std.	9	0.0000013	0.0000001	1276.00	0.000
Operator	2	0.0000000	0.0000000	1.00	0.373
Repeatability	78	0.0000000	0.0000000		
Total	89	0.0000013			

Gage R&R

Variance Components

Source	VarComp	%Contribution (of VarComp)
Total Gage R&R	0.0000000	0.70
Repeatability	0.0000000	0.70
Reproducibility	0.0000000	0.00
Operator	0.0000000	0.00
Part-To-Part	0.0000000	99.30
Total Variation	0.0000000	100.00

Gage Evaluation

Source	StdDev (SD)	Study Var (6 × SD)	%Study Var (%SV)
Total Gage R&R	0.0000105	0.0000632	8.37
Repeatability	0.0000105	0.0000632	8.37
Reproducibility	0.0000000	0.0000000	0.00
Operator	0.0000000	0.0000000	0.00
Part-To-Part	0.0001255	0.0007528	99.65
Total Variation	0.0001259	0.0007554	100.00

Number of Distinct Categories = 16

Gage R&R for Pb%

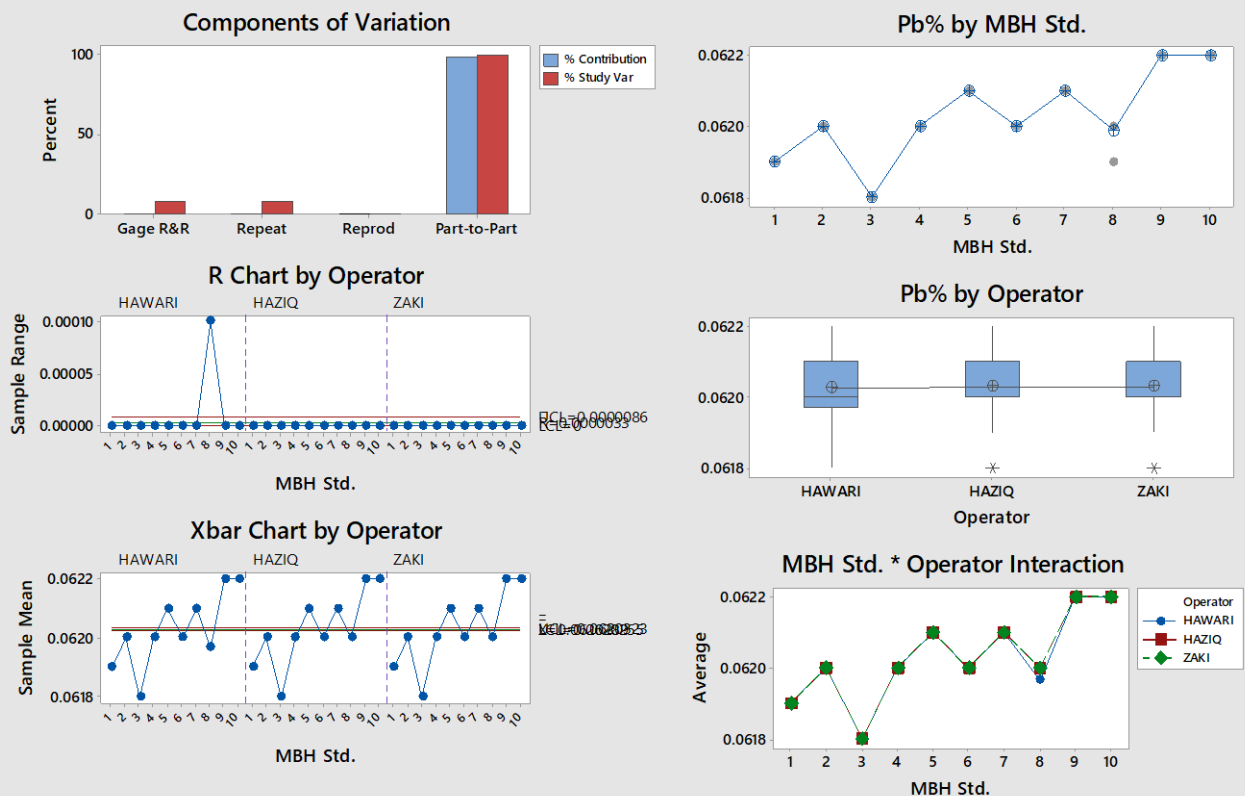
Table 1: Gauge R&R Study – ANOVA Method

2.0 ASSESSING MEASUREMENT SYSTEM VARIATIONS

Gage R&R (ANOVA) Report for Pb%

Gage name: VISCOMETER
Date of study: 27/08/2021

Reported by: AINI SYAREENA BT. YUSOFF
Tolerance: 0.0004
Misc:



Components of variation

Most variability in the measurements is due to part-part variability. However, some variabilities in the measurement system do exist. The variance component table (refer Table 1) indicates that the Gage R&R variation (8.37%) is within the AIAG recommended limit of below than 10% of the process variability or tolerance.

Pb% by MBH Std. (Measurements by parts)

The variability in measurements for MBH Std. 8 was detected. One of the operator (Hawari) apparently had difficulty measuring this point precisely.

Pb% by Operator (Measurements by operators)

On average, measurements done by Hawari appeared slightly lower than those two operators, Haziq and Zaki.

Operator & MBH Std. Interaction (Measurements by operator and part)

Each line represents interaction between operators. In addition, this point (MBH Std. 8) indicated disagreement between operators. Probable causes for the interactions are MBH Std. is a non-homogeneous sample and also operators are measuring at different points of each sample.