SOUTH QUALITY

PROFICIENCY TESTING PROVIDER

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ASTM E415

ANALYSIS OF CARBON AND LOW-ALLOY STEELS BY SPARK ATOMIC EMISSION SPECTROMETRY

Program: SQ-0047.V3

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Prepared by:	Reviewed by:	Approved by:
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1. FOREWORD

This report summarizes the results of the **SQ-0047.V3** proficiency testing program on the determination of the composition of carbon and low-alloy steel by spark atomic emission vacuum spectrometry. This program is conducted in a bilateral format, following the A.3.3 classification of the ISO 17043 standard ("Split-sample testing schemes").

South Quality conducted the testing program in August 2025 with the aim of assessing the laboratory's ability to competently perform the designated tests.

2. ORGANIZATION

Program Coordinator:	Eng. Alfredo Schmidt
Assistant Technician:	Sergio Andrada
Statistic:	Lic. Manuel Tozaki
Supervision:	Eng. Emiliano Medina

3. OBJECTIVE

The objective of this proficiency testing program is to determine the composition of carbon and low-alloy steel, using the following standard:

Standard
ASTM E415: 2021

To verify this, carbon and low-alloy steel samples have been selected.

Participants in this program have not been previously informed about the expected values or value ranges of the samples they receive.

4. PARTICIPANT

Company:	**COLUMBUS STAINLESS**
Laboratory:	**Instrument Laboratory**
Country:	South Africa
Client ID:	F290
Contact person:	Kebuile Moseki Lab Specialist moseki.kebuile@columbus.co.za

5. HOMOGENEITY

Several batches were prepared identically by the staff at South Quality.

Subsequently, a homogeneity study was conducted with an ISO 17025 accredited laboratory.

The control process followed ISO Guide 35: 2017, clause 7.4.1.2. Stratified random sampling was employed, and samples were chosen using random number generation software.

The results of this test are presented below:

Size of each batch: **50 units** Tested samples from each batch: **10 units**

DETERMINATION	HOMOGENEITY OF RESULTS IN THE ANALYZED SAMPLES		
	BATCH: LM2668	BATCH: LM2669	BATCH: LM2670
MASS FRACTION	NO	YES	YES

Size of each batch: **50 units** Tested samples from each batch: **10 units**

DETERMINATION	HOMOGENEITY OF RESULTS IN THE ANALYZED SAMPLES		
	BATCH: LM3039	BATCH: LM3040	BATCH: LM3041
MASS FRACTION	YES	YES	NO

Samples for this program are taken from the selected batches identified as LM2670 and LM3040.

For the indicated batches, the values determined in the homogeneity study are utilized as the assigned values.

The analysis of the test data indicated that the selected samples exhibited sufficient homogeneity for the program. Therefore, the results of participants identified as outliers cannot be attributed to sample variability.

6. SAMPLE INFORMATION

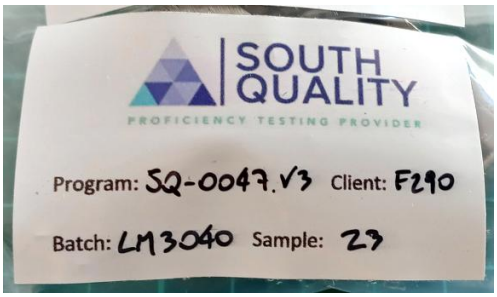
The following samples were sent to be tested:

Batch:	LM2670
Sample ID:	25
Characteristics:	Medium carbon steel (SAE 1045) - Ø 20 x 20 mm

Batch:	LM3040
Sample ID:	23
Characteristics:	Low carbon steel (SAE 1010) - 100 x 20 x 9 mm

7. IMAGES

SAMPLES



8. ASSIGNED VALUES

BATCH	MASS FRACTION, % (Standard deviation)					
	ALUMINUM	ANTIMONY	ARSENIC	BORON	CALCIUM	CARBON
LM2670	0.028 (0.006)	-	-	-	-	0.425 (0.051)
LM3040	-	-	-	-	-	0.079 (0.008)

BATCH	MASS FRACTION, % (Standard deviation)					
	CHROMIUM	COBALT	COPPER	MANGANESE	MOLYBDENUM	NICKEL
LM2670	0.0602 (0.0042)	-	-	-	0.0071 (0.0015)	0.0508 (0.0045)
LM3040	0.0425 (0.0055)	-	-	-	0.0039 (0.0005)	0.0488 (0.0078)

BATCH	MASS FRACTION, % (Standard deviation)				
	NIOBIUM	NITROGEN	PHOSPHOROUS	LEAD	SILICON
LM2670	-	0.0081 (0.0010)	-	-	-
LM3040	-	0.015 (0.004)	-	-	-

BATCH	MASS FRACTION, % (Standard deviation)				
	SULFUR	TIN	TITANIUM	VANADIUM	ZIRCONIUM
LM2670	-	0.0185 (0.008)	-	-	-
LM3040	-	0.0606 (0.0075)	-	-	-

9. PARTICIPANT RESULTS (SEE APPENDIX)

CODE	MASS FRACTION, %					
	ALUMINUM	ANTIMONY	ARSENIC	BORON	CALCIUM	CARBON
LM2670-25	0.022	-	-	-	-	0.415
LM3040-23	-	-	-	-	-	0.09

CODE	MASS FRACTION, %					
	CHROMIUM	COBALT	COPPER	MANGANESE	MOLYBDENUM	NICKEL
LM2670-25	0.0586	-	-	-	0.0069	0.0542
LM3040-23	0.0462	-	-	-	0.0043	0.0463

CODE	MASS FRACTION, %				
	NIOBIUM	NITROGEN	PHOSPHOROUS	LEAD	SILICON
LM2670-25	-	0.0082	-	-	-
LM3040-23	-	0.012	-	-	-

CODE	MASS FRACTION, %				
	SULFUR	TIN	TITANIUM	VANADIUM	ZIRCONIUM
LM2670-25	-	0.0172	-	-	-
LM3040-23	-	0.0628	-	-	-

10. STATISTICS

The results must be treated as quantitative.

The comparison is made according B.3.1.3 of ISO 17043 and the appropriate technique is to compare participant results with the assigned values. The results can be compare using percent difference ***z score.***

$$z = \frac{x - X}{\hat{\sigma}}$$

x is the participant's result

X is the assigned value

$\hat{\sigma}$ is the standard deviation

The performance evaluation of each sample is carried out with the following criteria:

$|z| \leq 2.0$ indicates "satisfactory" performance and generates no signal;

$2.0 < |z| < 3.0$ indicates "questionable" performance and generates a warning signal;

$|z| \geq 3.0$ indicates "unsatisfactory" performance and generates an action signal;

11. EVALUATION OF PERFORMANCE

A. BATCH LM2670

ELEMENT	MASS FRACTION, %		| z score |	PERFORMANCE RESULT
	PARTICIPANT RESULT	ASSIGNED VALUE		
ALUMINUM	0.022	0.028	**1.00**	SATISFACTORY
CARBON	0.415	0.425	**0.20**	SATISFACTORY
CHROMIUM	0.0586	0.0602	**0.38**	SATISFACTORY
MOLYBDENUM	0.0069	0.0071	**0.13**	SATISFACTORY
NICKEL	0.0542	0.0508	**0.76**	SATISFACTORY
NITROGEN	0.0082	0.0081	**0.10**	SATISFACTORY
TIN	0.0172	0.0185	**0.16**	SATISFACTORY

B. BATCH LM3040

ELEMENT	MASS FRACTION, %		| z score |	PERFORMANCE RESULT
	PARTICIPANT RESULT	ASSIGNED VALUE		
CARBON	0.09	0.079	**1.38**	SATISFACTORY
CHROMIUM	0.0462	0.0425	**0.67**	SATISFACTORY
MOLYBDENUM	0.0043	0.0039	**0.80**	SATISFACTORY
NICKEL	0.0463	0.0488	**0.32**	SATISFACTORY
NITROGEN	0.012	0.015	**0.75**	SATISFACTORY
TIN	0.0628	0.0606	**0.29**	SATISFACTORY

12. CONCLUSIONS

The overall performance on this **SQ-0047.V3** program from the participant laboratory **COLUMBUS STAINLESS - Instrument Laboratory**, is **SUFFICIENT** based on expected results.

The criteria used for the evaluation of the overall performance is the following:

- **SUFFICIENT** performance: No unsatisfactory/questionable results were obtained.
- **ALMOST SUFFICIENT** performance: No unsatisfactory results were obtained, but one questionable result was found.
- **INSUFFICIENT** performance: An unsatisfactory result or two questionable results were obtained.

APPENDIX

PARTICIPANT RESULTS

(Results form)

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INSTRUCTIVE
&
RESULTS FORM

PROGRAM:	Analysis of carbon and low-alloy steel by spark atomic emission spectrometry
CODE:	SQ-0047
VERSION:	3
STANDARD:	ASTM E415
COORDINATOR:	Eng. Alfredo Schmidt (aschmidt@ptsouthquality.com)

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1 - General

This document is intended to be filled with the results of the **SQ-0047.V3** program.

Results must be typed, not handwritten.

2 - Standard

ASTM E415: 2021

3 - Tests involved

TEST
Determination of the composition of carbon and low-alloy steel by spark atomic emission vacuum spectrometry

4 - Samples

CODE	SAMPLE	QUANTITY
LM2670-25	Carbon steel - Ø 20 x 20 mm	1
LM3040-23	Carbon steel - 100 x 20 x 9 mm	1

5 - Notes

a) Being a bilateral program there is no deadline to accomplish sending results.
b) Tables in this document can be modified at will for the addition of data or observations.
c) The samples must be kept until the end of the program, which closes with the submission of the final report.
d) The surfaces where the tests must be carried out are as follows:
- **LM2670**: Either of the two faces
- **LM3040**: Surface opposite the ID

e) Participants may improve the surface to provide a better testing surface. If this is done, the procedure must be detailed in the 'observations' box.
f) Samples should be treated as a routine laboratory sample. All testing, recording and reporting is to be performed in accordance with ASTM E415.
g) To review the results, sending images of the tests will be appreciated. Images can be attached at the end of this document or can be sent by email.
h) Once this document is completed, it is requested to transform it into a pdf file and send it to the program coordinator.

6 - **Test conditions**

Procedure:	According to standard
Final grinding:	P180 -grit

7 - **Test results**

ELEMENT	MASS FRACTION, %	
	LM2670-25	LM3040-23
ALUMINUM	0.0220	
ANTIMONY		
ARSENIC		
BORON		
CALCIUM		
CARBON	0.415	0.0900
CHROMIUM	0.0586	0.0462
COBALT		
COPPER		
MANGANESE		
MOLYBDENUM	0.0069	0.00430
NICKEL	0.0542	0.0463
NIOBIUM		
NITROGEN	0.0082	0.0120
PHOSPHORUS		
LEAD		
SILICON		
SULFUR		
TIN	0.0172	0.0628
TITANIUM		
VANADIUM		
ZIRCONIUM		

OBSERVATIONS
None

PHOTOGRAPHS

Before analysis

After analysis

----- END OF REPORT -----