

REPORT No 11676

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Status: FINAL REPORT

ASTM E1019

**DETERMINATION OF CARBON, SULFUR, NITROGEN, AND
OXYGEN IN STEEL, IRON, NICKEL, AND COBALT ALLOYS BY
COMBUSTION AND INERT GAS FUSION TECHNIQUES**

Program: SQ-0061.V5

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1. FOREWORD

This report summarizes the results of the **SQ-0061.V5** proficiency testing program on the determination of carbon and sulfur in steel. This program is conducted in a bilateral format, following the “split-sample” design described in clause A.4.2 of ISO/IEC 17043: 2023 (Alternative interlaboratory comparisons).

South Quality conducted the testing program in April 2026 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
 Statistics: Lic. Manuel Tozaki
 Supervision: Eng. Emiliano Medina

3. OBJECTIVE

The objective of this proficiency testing program is to determine the percentage of carbon and sulfur in steel, using the following standard:

Standard
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To verify this, batches of metallic steel samples have been selected.

Participants in this program have not been previously informed about the expected behavior of the samples they receive.

4. PARTICIPANT

Company: **INDURA S.A.**
 Laboratory: **Laboratorio Químico Roberto Díaz - Área Desarrollo de Soldadura**
 Country: Chile
 Client ID: C102
 Contact person: Gonzalo Zamorano Rojo
 Coordinador Laboratorio Químico - Gerencia Supply Chain
zamorage@airproducts.com

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 33405: 2024, clauses 7.4.1.1 / 7.4.1.2. Stratified random sampling was applied, and samples were selected using random number generation software.

The results of this test are presented below:

Size of each batch: **50 units**

Tested samples from each batch: **5 units**

DETERMINATION	HOMOGENEITY OF RESULTS IN THE ANALYZED SAMPLES		
	BATCH: LM2421	BATCH: LM2422	BATCH: LM2423
CARBON % (RANGE II)	NO	YES	YES
SULFUR % (RANGE II)	YES	YES	YES

The samples for this program are taken from the selected batch identified as **LM2423**.

For the indicated batch, 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 sample was sent for testing:

Batch:	LM2423
Sample ID:	18
Characteristics:	Steel - 57 x 12.7 x 12.7 mm

7. IMAGES



8. ASSIGNED VALUES

BATCH: LM2423		
	CARBON (%)	SULFUR (%)
AVG	0.45477	0.019113
SD	0.00169	0.000607

9. PARTICIPANT RESULTS (SEE APPENDIX)

	CODE: LM2423-18	
	CARBON (%)	SULFUR (%)
AVG	0.45378	0.018903

10. STATISTICS

The results must be treated as quantitative.

According to B.4.1.3 of ISO 17043 the appropriate technique is to compare participant results with the assigned values. The results can be compared using **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

BATCH	PARAMETER	AVERAGE		z score	PERFORMANCE RESULT
		PARTICIPANT RESULT	ASSIGNED VALUE		
LM2423	CARBON (%)	0.45378	0.45477	0.59	SATISFACTORY
	SULFUR (%)	0.018903	0.019113	0.35	SATISFACTORY

12. CONCLUSIONS

The overall performance on this **SQ-0061.V5** program from the participant laboratory **INDURA S.A. - Laboratorio Químico Roberto Díaz - Área Desarrollo de Soldadura**, is **SUFFICIENT** based on expected results.

The criteria used for evaluating the overall performance are as follows:

- **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 was obtained, or two questionable results were obtained.

APPENDIX

PARTICIPANT RESULTS

(Result form)



INSTRUCTIONS & RESULTS FORM

PROGRAM:	Determination of carbon, sulfur, nitrogen, and oxygen in steel, iron, nickel, and cobalt alloys by combustion and inert gas fusion techniques
CODE:	SQ-0061
VERSION:	5
STANDARD:	ASTM E1019
COORDINATOR:	Eng. Alfredo Schmidt (aschmidt@ptsouthquality.com)

1 - General

This document serves as a guide for managing the results of the **SQ-0061.V5** program.

Results must be typed, not handwritten.

2 - Standard

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3 - Tests involved

TEST
Determination of carbon and sulfur in steel Carbon % (Range II) Sulfur % (Range II)

4 - Samples

CODE	SAMPLE	QUANTITY
LM2423-18	Steel - 57x12.7x12.7 mm	1

5 - Notes

- a) Being a bilateral program, there is no deadline for submitting results.
- b) The tables in this document may be modified by the participant, if desired, to include data or observations.
- c) The samples are to be handled as routine lab samples, with all testing, documentation, and reporting adhering to **ASTM E1019**.
- d) Samples must be retained until the end of the program, which concludes with the submission of the final report.
- e) To review the results, test images would be appreciated. Images can be attached at the end of this document or sent by email.
- f) Once this document is completed, it must be converted into a PDF file and sent to the program coordinator.

6 - Test results

ELEMENT	LM2423-18 M1	LM2423-18 M2	LM2423-18 M3	LM2423-18 Promedio
CARBON (%)	0.45543	0.45419	0.45173	0.45378
SULFUR (%)	0.01840	0.019333	0.019237	0.018903

OBSERVATIONS

Se realizan mediciones con equipo LECO CS-744, Utilizando método 022026 previamente calibrado el 24-02-2026.

Se realiza la extracción de viruta metálica de la muestra LM2423-18 (Aproximadamente 3 gramos) con torno a velocidad baja. Luego fueron limpiadas con acetona y reacondicionadas a 90°C por 1 hora en Estufa LQ-07, Calibrada el 09-09-2024.

Se adjuntan fotografía de muestra y de ensayos realizados.

PHOTOGRAPHS


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