SOUTH QUALITY

PROFICIENCY TESTING PROVIDER

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ASTM E415

ANALYSIS OF CARBON STEEL BY SPARK ATOMIC EMISSION SPECTROMETRY

Program: SQO-M6 Round 18

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TABLE OF CONTENTS

1. FOREWORD

This report summarizes the results of the **SQO-M6 (Round 18)** proficiency testing program on the determination of composition of carbon steels. This program is carried out under a simultaneous participation format, according to the A.3.1 classification of the ISO 17043 standard ("Model 2 - Figure A.1").

South Quality conducted the testing program in September/October 2025. The aim of the program was to assess laboratory ability to competently perform the nominated tests.

2. ORGANIZATION

Program Coordinator:	Eng. Erika Brest
Assistant Technician:	Mateo Giovanni
Statistic:	Lic. Manuel Tozaki
Supervision:	Eng. Emiliano Medina

3. OBJECTIVE

The objective of this proficiency testing program is to determine the composition of carbon steel samples.

These parameters are verified using the following standard:

Standard
ASTM E415 - 2021

Batches of steels samples have been selected.

Participants in this program have not been previously informed of the values or range of values expected from the samples they receive.

4. PARTICIPANTS

In the present round, 19 laboratories have participated with the following details:

CODE	Country	ISO 17025 Accredited	Results delivered
01	Spain	No	Yes
02	Hong Kong	Yes	No
03	Germany	Yes	Yes
04	Türkiye	No	Yes
05	Canada	Yes	Yes
06	Mexico	Yes	Yes
07	England	Yes	Yes
08	Portugal	Yes	Yes
09	Mexico	Yes	Yes
10	Italy	No	Yes
11	Brazil	Yes	Yes
12	South Africa	Yes	Yes
13	Spain	Yes	No
14	Spain	Yes	Yes
15	Malaysia	No	Yes
16	France	Yes	Yes
17	Germany	Yes	Yes
18	Chile	Yes	No
19	Argentina	No	No

5. HOMOGENEITY

Several batches were prepared identically by South Quality staff.

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 employed, and samples were chosen using random number generation software.

The results of these tests are presented below:

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

DETERMINATION	SAE 1045 - HOMOGENEITY OF RESULTS IN THE ANALYZED SAMPLES		
	BATCH: LM3244	BATCH: LM3245	BATCH: LM3246
Element composition	YES	YES	YES

DETERMINATION	SAE 1010 - HOMOGENEITY OF RESULTS IN THE ANALYZED SAMPLES		
	BATCH: LM3426	BATCH: LM3427	BATCH: LM3428
Element composition	NO	YES	YES

Samples for this program are taken from selected batches identified as **LM3245** and **LM3428**.

Analysis of this testing data indicated that samples were sufficiently homogeneous for the program and, therefore, any participant results identified as outliers cannot be attributed to sample variability.

6. SAMPLE INFORMATION

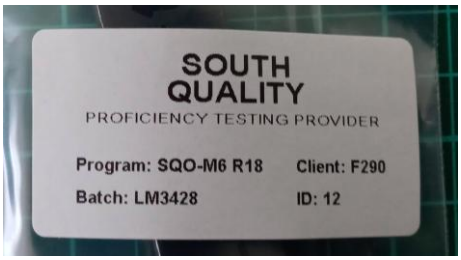
The following samples were sent for testing (Participant **Code 12**):

Batch:	LM3245
Sample ID:	12
Observation:	Carbon steel (SAE 1045) - Ø20 x 20 mm

Batch:	LM3428
Sample ID:	12
Observation:	Carbon steel (SAE 1010) - 20 x 10 x 80 mm

7. IMAGES

SAMPLES



8. ASSIGNED VALUES

The assigned values are obtained from the results reported by all participants (**Consensus values**).

9. PARTICIPANTS' RESULTS

ELEMENT	MASS FRACTION, % - BATCH: LM3245																
	LAB 01	LAB 03	LAB 04	LAB 05	LAB 06	LAB 07	LAB 08	LAB 09	LAB 10	LAB 11	LAB 12	LAB 14	LAB 15	LAB 16	LAB 17	ASSIGNED VALUE	
																AVG	SD
ALUMINUM	0.021	0.0215	0.0325	NV	0.0238	0.0205	0.0211	0.0201	0.0245	0.02207	0.022	0.0209	0.0212	0.0235	0.0232	**0.0220**	**0.00138**
ANTIMONY	NV	0.0043	0.0038	NV	0.0036	0.003	0.0033	0.0057	NV	0.0037	NV	0.0033	0.004	NV	0.0033	**0.0038**	**0.00077**
ARSENIC	NV	0.004	0.0035	NV	0.0032	0.0037	0.0036	0.004	NV	0.00409	NV	0.0034	0.0039	NV	0.004	**0.0037**	**0.00030**
BORON	< LOQ	< LOQ	NV	< LOQ	< LOQ	< LOQ	NV	< LOQ	< LOQ	< LOQ	< LOQ	< LOQ	< LOQ	NV	< LOQ	**< LOQ**	-
CALCIUM	NV	0.0017	0.0022	0.0022	0.0016	0.0022	0.0021	0.0014	NV	0.00207	NV	0.0021	0.0023	0.002	0.0016	**0.0020**	**0.00030**
CARBON	0.42	0.3985	0.4278	0.4128	0.4414	0.4361	0.392	0.4295	0.44	0.40075	0.43	0.4132	0.4335	0.4453	0.4146	**0.4224**	**0.01659**
CHROMIUM	0.062	0.065	0.0584	0.0655	0.0668	0.0699	0.0688	0.0995	0.065	0.06339	0.059	0.062	0.0699	0.0677	0.0819	**0.0661**	**0.00583**
COBALT	NV	0.0047	0.0056	0.0055	0.005	0.0058	0.0047	0.0048	NV	0.00466	NV	0.0045	0.0058	0.0054	0.0051	**0.0051**	**0.00047**
COPPER	0.135	0.1262	0.1335	0.1417	0.1401	0.1346	0.1356	0.1352	0.139	0.13371	NV	0.1321	0.1456	0.1335	0.1271	**0.1352**	**0.00522**
LEAD	NV	0.002	0.0022	NV	0.0013	0.0019	0.0021	0.0028	0.0014	< 0.001	NV	0.0019	0.0018	0.0022	0.0018	**0.0019**	**0.00041**
MANGANESE	0.715	0.6482	0.7297	0.643	0.7139	0.7577	0.6999	0.6512	0.721	0.71221	NV	0.7117	0.7356	0.6988	0.7148	**0.7038**	**0.03392**
MOLYBDENUM	NV	0.0099	0.0081	0.0077	0.009	0.0066	0.0075	0.0088	NV	0.00932	0.0071	0.0086	0.0095	0.0062	0.00902	**0.0083**	**0.00116**
NICKEL	0.055	0.0535	0.0603	0.0531	0.0555	0.0537	0.0621	0.0626	0.058	0.05646	0.054	0.0567	0.0603	0.0597	0.062	**0.0575**	**0.00340**
NIOBIUM	0.0006	0.0006	0.0006	NV	0.0005	0.0005	NV	0.0005	0.0006	< 0.001	NV	0.0005	0.0007	NV	0.0006	**0.0006**	**0.00007**
NITROGEN	0.0076	0.0092	0.0094	NV	0.012	0.0086	0.0091	0.0089	0.0089	NV	0.0071	0.0086	0.0078	0.0095	0.0063	**0.0087**	**0.00138**
PHOSPHOROUS	0.0145	0.0168	0.0145	0.0152	0.0162	0.0147	0.0158	0.0153	0.0153	0.01402	NV	0.0156	0.0148	0.015	0.0159	**0.0153**	**0.00075**
SILICON	0.248	0.2324	0.2198	0.2299	0.2166	0.2358	0.229	0.255	0.259	0.23861	0.243	0.2294	0.2489	0.2377	0.2286	**0.2368**	**0.01221**
SULFUR	0.011	0.0112	0.0108	0.016	0.0112	0.015	0.0123	0.0111	0.014	0.01006	0.012	0.0119	0.0106	0.0107	0.0115	**0.0120**	**0.00172**
TIN	NV	0.0172	0.016	NV	0.0157	0.0159	0.0158	0.0138	NV	0.01648	0.018	0.0173	0.0176	0.018	0.0173	**0.0166**	**0.00122**
TITANIUM	NV	0.0012	0.0013	NV	0.0011	0.0013	0.0013	0.0011	NV	0.00109	NV	0.0013	0.0011	NV	0.0011	**0.0012**	**0.00010**
VANADIUM	< LOQ	< LOQ	< LOQ	NV	< LOQ	< LOQ	< LOQ	< LOQ	< LOQ	0.00112	NV	< LOQ	< LOQ	< LOQ	< LOQ	**< LOQ**	-
ZIRCONIUM	NV	NV	NV	NV	NV	NV	NV	NV	NV	0.001	NV	NV	NV	NV	NV	-	-

ELEMENT	MASS FRACTION, % - BATCH: LM3428																
	LAB 01	LAB 03	LAB 04	LAB 05	LAB 06	LAB 07	LAB 08	LAB 09	LAB 10	LAB 11	LAB 12	LAB 14	LAB 15	LAB 16	LAB 17	ASSIGNED VALUE	
																AVG	SD
ALUMINUM	< LOQ	< LOQ	< LOQ	NV	< LOQ	< LOQ	< LOQ	< LOQ	< LOQ	< LOQ	< LOQ	< LOQ	< LOQ	< LOQ	< LOQ	**< LOQ**	**-**
ANTIMONY	NV	0.00225	0.00213	0.00232	0.00215	0.00236	0.00245	0.00209	NV	0.00219	NV	0.00212	0.0022	NV	0.0023	**0.0022**	**0.00011**
ARSENIC	NV	0.00408	0.00392	0.00385	0.00412	0.00409	0.00381	0.0048	NV	0.00396	NV	0.00403	0.00369	NV	0.0034	**0.0040**	**0.00036**
BORON	< LOQ	< LOQ	NV	< LOQ	< LOQ	< LOQ	-	< LOQ	< LOQ	0.00026	< LOQ	< LOQ	< LOQ	NV	< LOQ	**< LOQ**	**-**
CALCIUM	NV	0.00037	0.0004	0.00037	0.00039	0.0004	0.00038	0.00036	NV	0.00038	NV	0.0004	0.00041	0.00037	0.00036	**0.0004**	**0.00002**
CARBON	0.1785	0.1606	0.155	0.1784	0.158	0.1821	0.1685	0.1611	0.177	0.1676	0.161	0.1558	0.167	0.1853	0.1716	**0.1685**	**0.00992**
CHROMIUM	0.0507	0.0449	0.049	0.0476	0.0389	0.0442	0.0487	0.0447	0.047	0.04559	0.04	0.0437	0.0489	0.049	0.043	**0.0457**	**0.00344**
COBALT	NV	0.00204	0.00235	0.00224	0.00183	0.00204	0.00182	0.00188	NV	0.00207	NV	0.00192	0.00192	0.00203	0.00221	**0.0020**	**0.00017**
COPPER	0.0928	0.0843	0.0939	0.0846	0.0868	0.0826	0.0869	0.085	0.079	0.078	NV	0.0792	0.066	0.0924	0.0915	**0.0845**	**0.00748**
LEAD	NV	0.0012	0.0011	NV	0.0013	0.0013	0.0012	0.0011	0.0013	< 0.001	NV	0.0013	0.0012	0.0012	0.0012	**0.0012**	**0.00008**
MANGANESE	0.7413	0.6786	0.785	0.7761	0.6853	0.7515	0.7656	0.7508	0.714	0.71808	NV	0.6672	0.7119	0.7251	0.7475	**0.7299**	**0.03625**
MOLYBDENUM	NV	0.0032	0.0034	0.0044	0.0046	0.004	0.0037	0.0041	NV	0.00382	0.004	0.0039	0.0046	0.0042	0.0042	**0.0040**	**0.00042**
NICKEL	0.0232	0.0206	0.0207	0.0259	0.021	0.0197	0.0206	0.0229	0.026	0.02512	0.0216	0.0246	0.0223	0.0246	0.0244	**0.0229**	**0.00212**
NIOBIUM	0.0004	0.0005	0.0006	NV	0.0006	0.0004	NV	0.0004	0.0005	< 0.001	NV	0.0005	0.0005	NV	0.0004	**0.0005**	**0.00008**
NITROGEN	0.0086	0.009	0.0082	NV	0.0091	0.007	0.0069	0.0078	0.0089	NV	0.0071	0.0079	0.0077	0.0088	0.0091	**0.0082**	**0.00082**
PHOSPHOROUS	0.0133	0.0143	0.0175	0.0173	0.0127	0.0176	0.0142	0.0097	0.0135	0.0136	NV	0.0155	0.0145	0.0166	0.0153	**0.0147**	**0.00218**
SILICON	0.1532	0.2061	0.2146	0.1567	0.151	0.1623	0.206	0.1566	0.182	0.17568	0.179	0.183	0.1619	0.1997	0.1769	**0.1776**	**0.02103**
SULFUR	0.0161	0.0149	0.0123	0.0173	0.0158	0.0127	0.0122	0.0118	0.015	0.01542	0.0128	0.017	0.0146	0.012	0.013	**0.0142**	**0.00189**
TIN	NV	0.0053	0.0052	NV	0.006	0.0043	0.0055	0.0051	NV	0.00555	0.004	0.0042	0.004	0.005	0.0043	**0.0049**	**0.00068**
TITANIUM	NV	0.0004	0.0003	NV	0.0003	0.0002	0.0003	0.0003	NV	0.00034	NV	0.0004	0.0002	NV	0.0002	**0.0003**	**0.00008**
VANADIUM	< LOQ	< LOQ	< LOQ	NV	0.0004	< LOQ	< LOQ	< LOQ	< LOQ	< LOQ	NV	< LOQ	< LOQ	< LOQ	< LOQ	**< LOQ**	**-**
ZIRCONIUM	NV	NV	NV	NV	NV	NV	NV	NV	NV	< LOQ	NV	NV	NV	NV	NV	**-**	**-**

NV: NOT VERIFIED
LOQ: LIMIT OF QUANTIFICATION

10. STATISTICS

The results must be treated as qualitative as quantitative.

According B.3.1.3 of ISO 17043 the appropriate technique is to compare participant results with the assigned values.

a) For **quantitative** results the comparison will be made through ***z score*** (B3 - ISO 17043).

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

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;

b) For the qualitative comparison, several situations may occur, as follows:

i) When more than 70% of the laboratories report a value <LOQ, this indication is adopted as the assigned value for the element in question.
ii) When <LOQ is adopted as the assigned value for an element, any numerical results reported by the remaining laboratories, as well as the <LOQ indications, will not be evaluated (**NE**).
iii) When a numerical value is assigned to an element and a <LOQ value *above* that numerical value is reported, it will be considered qualitatively satisfactory (**S**).
iv) When a numerical value is assigned to an element and a <LOQ value *below* that numerical value is reported, it will be considered qualitatively unsatisfactory (**NS**).
v) In cases where the minimum number of results required to calculate the assigned value and the standard deviation is not reached, the numerical results reported by one or more participants will not be evaluated (**NE**).

11. EVALUATION OF PERFORMANCE

ELEMENT	EVALUATION (QUANTITATIVE/QUALITATIVE) - BATCH: LM3245														
	LAB 01	LAB 03	LAB 04	LAB 05	LAB 06	LAB 07	LAB 08	LAB 09	LAB 10	LAB 11	LAB 12	LAB 14	LAB 15	LAB 16	LAB 17
ALUMINUM	-0.72	-0.36	7.61	-	1.30	-1.09	-0.65	-1.38	1.81	0.05	0	-0.80	-0.58	1.09	0.87
ANTIMONY	-	0.65	0	-	-0.26	-1.04	-0.65	2.47	-	-0.13	-	-0.65	0.26	-	-0.65
ARSENIC	-	1.00	-0.67	-	-1.67	0	-0.33	1.00	-	1.30	-	-1.00	0.67	-	1.00
BORON	NE	NE	-	NE	NE	NE	-	NE	NE	NE	NE	NE	NE	-	NE
CALCIUM	-	-1.00	0.67	0.67	-1.33	0.67	0.33	-2.00	-	0.23	-	0.33	1.00	0	-1.33
CARBON	-0.14	-1.44	0.33	-0.58	1.15	0.83	-1.83	0.43	1.06	-1.31	0.46	-0.55	0.67	1.38	-0.47
CHROMIUM	-0.7	-0.19	-1.32	-0.1	0.12	0.65	0.46	5.73	-0.19	-0.46	-1.22	-0.70	0.65	0.27	2.71
COBALT	-	-0.85	1.06	0.85	-0.21	1.49	-0.85	-0.64	-	-0.94	-	-1.28	1.49	0.64	0
COPPER	-0.04	-1.72	-0.33	1.25	0.94	-0.11	0.08	0	0.73	-0.29	-	-0.59	1.99	-0.33	-1.55
LEAD	-	0.24	0.73	-	-1.46	0	0.49	2.20	-1.22	NS	-	0	-0.24	0.73	-0.24
MANGANESE	0.33	-1.64	0.76	-1.79	0.30	1.59	-0.11	-1.55	0.51	0.25	-	0.23	0.94	-0.15	0.32
MOLYBDENUM	-	1.38	-0.17	-0.52	0.60	-1.47	-0.69	0.43	-	0.88	-1.03	0.26	1.03	-1.81	0.62
NICKEL	-0.74	-1.18	0.82	-1.29	-0.59	-1.12	1.35	1.50	0.15	-0.31	-1.03	-0.24	0.82	0.65	1.32
NIOBIUM	0	0	0	-	-1.43	-1.43	-	-1.43	0	S	-	-1.43	1.43	-	0
NITROGEN	-0.8	0.36	0.51	-	2.39	-0.07	0.29	0.14	0.14	-	-1.16	-0.07	-0.65	0.58	-1.74
PHOSPHOROUS	-1.07	2.00	-1.07	-0.13	1.20	-0.80	0.67	0.00	0.00	-1.71	-	0.40	-0.67	-0.40	0.80
SILICON	0.92	-0.36	-1.39	-0.57	-1.65	-0.08	-0.64	1.49	1.82	0.15	0.51	-0.61	0.99	0.07	-0.67
SULFUR	-0.58	-0.47	-0.70	2.33	-0.47	1.74	0.17	-0.52	1.16	-1.13	0	-0.06	-0.81	-0.76	-0.29
TIN	-	0.49	-0.49	-	-0.74	-0.57	-0.66	-2.30	-	-0.10	1.15	0.57	0.82	1.15	0.57
TITANIUM	-	0	1.00	-	-1.00	1.00	1.00	-1.00	-	-1.10	-	1.00	-1.00	-	-1.00
VANADIUM	NE	NE	NE	-	NE	NE	NE	NE	NE	NE	-	NE	NE	NE	NE
ZIRCONIUM	-	-	-	-	-	-	-	-	-	NE	-	-	-	-	-

ELEMENT	EVALUATION (QUANTITATIVE/QUALITATIVE) - BATCH: LM3428														
	LAB 01	LAB 03	LAB 04	LAB 05	LAB 06	LAB 07	LAB 08	LAB 09	LAB 10	LAB 11	LAB 12	LAB 14	LAB 15	LAB 16	LAB 17
ALUMINUM	NE	NE	NE	-	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
ANTIMONY	-	0.45	-0.64	1.09	-0.45	1.45	2.27	-1.00	-	-0.09	-	-0.73	0	-	0.91
ARSENIC	-	0.22	-0.22	-0.42	0.33	0.25	-0.53	2.22	-	0.11	-	0.08	-0.86	-	-1.94
BORON	NE	NE	-	NE	NE	NE	-	NE	NE	NE	NE	NE	NE	-	NE
CALCIUM	-	-1.50	0	-1.50	-0.50	0	-1.00	-2.00	-	-1.00	-	0	0.50	-1.50	-2.00
CARBON	1.01	-0.80	-1.36	1.00	-1.06	1.37	0	-0.75	0.86	-0.09	-0.76	-1.28	-0.15	1.69	0.31
CHROMIUM	1.45	-0.23	0.96	0.55	-1.98	-0.44	0.87	-0.29	0.38	-0.03	-1.66	-0.58	0.93	0.96	-0.78
COBALT	-	0.24	2.06	1.41	-1.00	0.24	-1.06	-0.71	-	0.41	-	-0.47	-0.47	0.18	1.24
COPPER	1.11	-0.03	1.26	0.01	0.31	-0.25	0.32	0.07	-0.74	-0.87	-	-0.71	-2.47	1.06	0.94
LEAD	-	0	-1.25	-	1.25	1.25	0	-1.25	1.25	NS	-	1.25	0	0	0
MANGANESE	0.31	-1.42	1.52	1.27	-1.23	0.60	0.98	0.58	-0.44	-0.33	-	-1.73	-0.50	-0.13	0.49
MOLYBDENUM	-	-1.90	-1.43	0.95	1.43	0	-0.71	0.24	-	-0.43	0	-0.24	1.43	0.48	0.48
NICKEL	0.14	-1.08	-1.04	1.42	-0.90	-1.51	-1.08	0	1.46	1.05	-0.61	0.80	-0.28	0.80	0.71
NIOBIUM	-1.25	0	1.25	-	1.25	-1.25	-	-1.25	0	S	-	0	0	-	-1.25
NITROGEN	0.49	0.98	0	-	1.10	-1.46	-1.59	-0.49	0.85	-	-1.34	-0.37	-0.61	0.73	1.10
PHOSPHOROUS	-0.64	-0.18	1.28	1.19	-0.92	1.33	-0.23	-2.29	-0.55	-0.50	-	0.37	-0.09	0.87	0.28
SILICON	-1.16	1.36	1.76	-0.99	-1.26	-0.73	1.35	-1.00	0.21	-0.09	0.07	0.26	-0.75	1.05	-0.03
SULFUR	1.01	0.37	-1.01	1.64	0.85	-0.79	-1.06	-1.27	0.42	0.65	-0.74	1.48	0.21	-1.16	-0.63
TIN	-	0.59	0.44	-	1.62	-0.88	0.88	0.29	-	0.96	-1.32	-1.03	-1.32	0.15	-0.88
TITANIUM	-	1.25	0	-	0	-1.25	0	0	-	0.50	-	1.25	-1.25	-	-1.25
VANADIUM	NE	NE	NE	-	NE	NE	NE	NE	NE	NE	-	NE	NE	NE	NE
ZIRCONIUM	-	-	-	-	-	-	-	-	-	NE	-	-	-	-	-

Laboratory **Code 01**: The laboratory obtained **SATISFACTORY** results for the assigned-value elements it analyzed.

Laboratory **Code 02**: The laboratory has not sent the results before the deadline.

Laboratory **Code 03**: The laboratory obtained **SATISFACTORY** results for the assigned-value elements it analyzed.

Laboratory **Code 04**: The laboratory obtained an **UNSATISFACTORY** result for *aluminum* (LM3245) and a **QUESTIONABLE** result for *cobalt* (LM3428). All other assigned-value elements it analyzed showed **SATISFACTORY** performance.

Laboratory **Code 05**: The laboratory obtained a **QUESTIONABLE** result for *sulfur* (LM3245), while all other assigned-value elements it analyzed showed **SATISFACTORY** performance.

Laboratory **Code 06**: The laboratory obtained a **QUESTIONABLE** result for *nitrogen* (LM3245), while all other assigned-value elements it analyzed showed **SATISFACTORY** performance.

Laboratory **Code 07**: The laboratory obtained **SATISFACTORY** results for the assigned-value elements it analyzed.

Laboratory **Code 08**: The laboratory obtained a **QUESTIONABLE** result for *antimony* (LM3428), while all other assigned-value elements it analyzed showed **SATISFACTORY** performance.

Laboratory **Code 09**: The laboratory obtained an **UNSATISFACTORY** result for chromium (LM3245) and **QUESTIONABLE** results for *antimony, lead, tin* (LM3245) and *arsenic, phosphorus* (LM3428). All other assigned-value elements it analyzed showed **SATISFACTORY** performance

Laboratory **Code 10**: The laboratory obtained **SATISFACTORY** results for the assigned-value elements it analyzed.

Laboratory **Code 11**: The laboratory obtained **UNSATISFACTORY** results for *lead* in both samples, as it reported an LOQ value lower than the assigned value. All other assigned-value elements analyzed showed **SATISFACTORY** performance.

Laboratory **Code 12**: The laboratory obtained **SATISFACTORY** results for the assigned-value elements it analyzed.

Laboratory **Code 13**: The laboratory has not sent the results before the deadline.

Laboratory **Code 14**: The laboratory obtained **SATISFACTORY** results for the assigned-value elements it analyzed.

Laboratory **Code 15**: The laboratory obtained a **QUESTIONABLE** result for *copper* (LM3245), while all other assigned-value elements it analyzed showed **SATISFACTORY** performance.

Laboratory **Code 16**: The laboratory obtained **SATISFACTORY** results for the assigned-value elements it analyzed.

Laboratory **Code 17**: The laboratory obtained a **QUESTIONABLE** result for *chromium* (LM3245), while all other assigned-value elements it analyzed showed **SATISFACTORY** performance.

Laboratory **Code 18**: The laboratory has not sent the results before the deadline.

Laboratory **Code 19**: The laboratory has not sent the results before the deadline.

12. CONCLUSIONS

The overall performance in this **SQO-M6 (Round 18)** program by the participating laboratories, based on the expected results, is as follows:

- Laboratories Codes **01, 03, 07, 10, 12, 14** and **16** have obtained a **SUFFICIENT** performance according to the expected results and should not take action;

- Laboratories Codes **05, 06, 08, 15** and **17** have obtained an **ALMOST SUFFICIENT** performance according to the expected results and must evaluate if it is necessary to take action in the tests where they have obtained a different result than expected;

- Laboratories Codes **04, 09,** and **11** have obtained an **INSUFFICIENT** performance in accordance with the expected results and must take action in the tests where they have obtained a different result than expected (See **Appendix B**).

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.

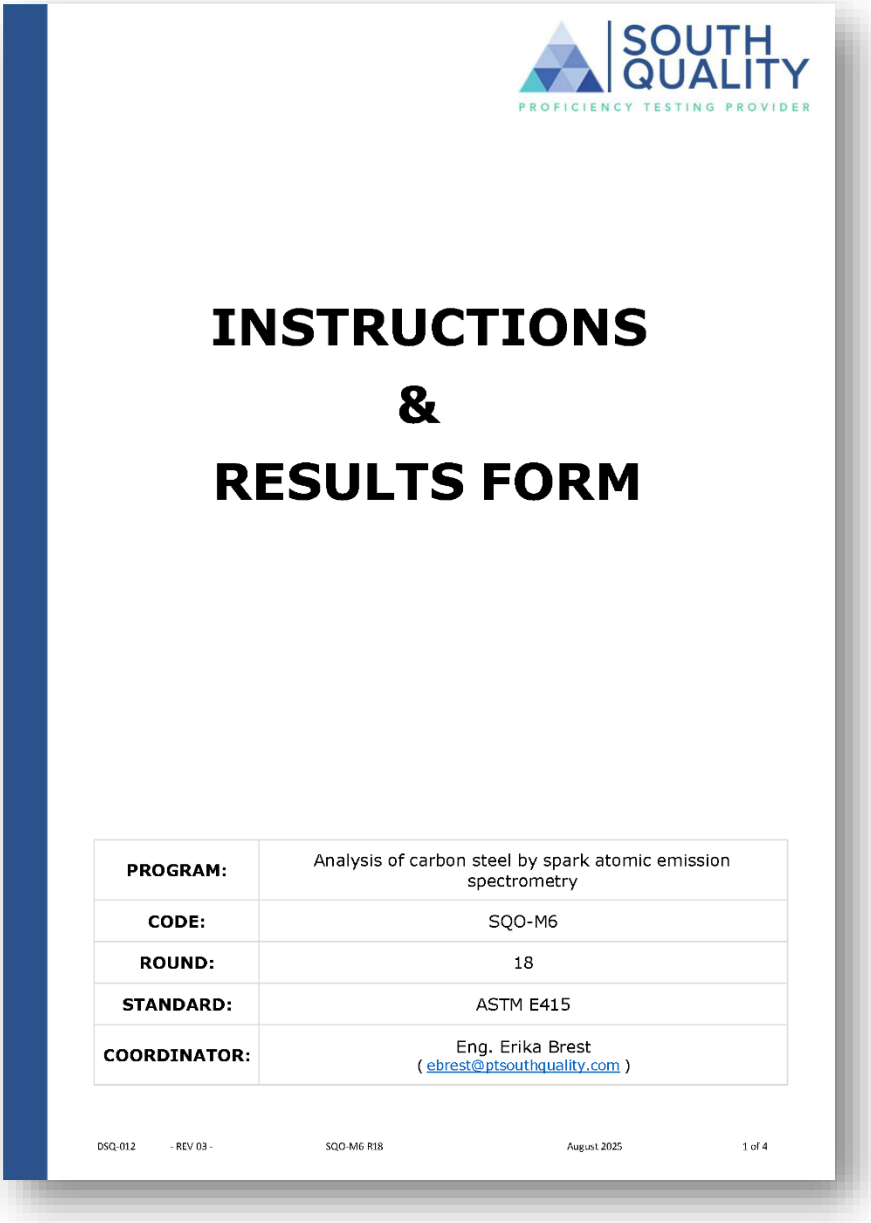
- **INSUFFICIENT** performance: An unsatisfactory result or two questionable results were obtained.

APPENDIX A

A1 - PARTICIPANT DATA

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

A2 - PARTICIPANT RESULTS



INSTRUCTIONS
&
RESULTS FORM

PROGRAM:	Analysis of carbon steel by spark atomic emission spectrometry
CODE:	SQO-M6
ROUND:	18
STANDARD:	ASTM E415
COORDINATOR:	Eng. Erika Brest (ebrest@ptsouthquality.com)

DSQ-012 - REV 03 - SQO-M6 R18 August 2025 1 of 4

1 - **General**

This document is intended to be filled with the results of the **SQO-M6 (Round 18)** program.

Results must be typed, not handwritten.

2 - **Standard**

ASTM E415: 2021

3 - **Participant**

COLUMBUS STAINLESS Instrument Laboratory	**CODE 12**

4 - **Tests involved**

TEST
Determination of composition of carbon steel

5 - **Samples**

CODE	SAMPLE	QUANTITY
LM3245-12	Steel - D20 x 20 mm	1
LM3428-12	Steel - 20 x 10 x 80 mm	1

6 - **Notes**

a) The deadline for the delivery of results is **October 3, 2025**.
b) The tables in this document may be modified by the participant, if desired, to include data or observations.
c) For specimens from batch LM3245, measurements may be performed on both sides.
d) For specimens from batch LM3428, measurements must be conducted on the side opposite the identification mark.
e) The samples are to be handled as routine lab samples, with all testing, documentation, and reporting adhering to ASTM E415.
f) The samples must be kept until the end of the program, which closes with the submission of the final report.
g) To review the results, the submission of images of the tests is appreciated. These images can be attached at the end of this document or sent via email.
h) Upon completion of this document, please convert it to a PDF file and send it to the program coordinator.

7 - **Test conditions**

Procedure:	According to standard
Final grinding:	-grit

8 - **Test results**

ELEMENT	MASS FRACTION, %	
	LM3245-12	LM3428-12
ALUMINUM	0.022	<0.001% (LOQ)
ANTIMONY	Element not verified by spark atomic emission spectrometry	Element not verified by spark atomic emission spectrometry
ARSENIC	Element not verified by spark atomic emission spectrometry	Element not verified by spark atomic emission spectrometry
BORON	<0.0003 (LOQ)	<0.0003 (LOQ)
CALCIUM	Element not verified by spark atomic emission spectrometry	Element not verified by spark atomic emission spectrometry
CARBON	0.430	0.161
CHROMIUM	0.059	0.040
COBALT	Element not verified by spark atomic emission spectrometry	Element not verified by spark atomic emission spectrometry
COPPER	Element not verified by spark atomic emission spectrometry	Element not verified by spark atomic emission spectrometry
LEAD	Element not verified by spark atomic emission spectrometry	Element not verified by spark atomic emission spectrometry
MANGANESE	Element not verified by spark atomic emission spectrometry	Element not verified by spark atomic emission spectrometry
MOLYBDENUM	0.0071	0.0040
NICKEL	0.054	0.0216
NIOBIUM	Element not verified by spark atomic emission spectrometry	Element not verified by spark atomic emission spectrometry
NITROGEN	0.0071	0.0071
PHOSPHOROUS	Element not verified by spark atomic emission spectrometry	Element not verified by spark atomic emission spectrometry
SILICON	0.243	0.179
SULFUR	0.012	0.0128
TIN	0.018	0.0040
TITANIUM	Element not verified by spark atomic emission spectrometry	Element not verified by spark atomic emission spectrometry
VANADIUM	Element not verified by spark atomic emission spectrometry	Element not verified by spark atomic emission spectrometry
ZIRCONIUM	Element not verified by spark atomic emission spectrometry	Element not verified by spark atomic emission spectrometry

OBSERVATIONS

PHOTOGRAPHS
Before analysis  **After analysis** 

APPENDIX B

VOID

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