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Status: FINAL REPORT

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ISO 6508-1

ROCKWELL HARDNESS TEST - HRC

Program: SQO-M9 (Round 18)

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Prepared by:	Reviewed by:	Approved by:
cn=SERGIO E. ANDRADA, o=PT SOUTH QUALITY SAS, ou=PT SOUTH QUALITY SAS, email=tech@ptsouthquality.com, c=AR 2026.01.09 14:37:09 -03'00'	cn=ALFREDO M. SCHMIDT, o=PT SOUTH QUALITY SAS, ou=SOUTH QUALITY, email=aschmidt@ptsouthquality.com, c=AR 2026.01.12 10:14:07 -03'00'	cn=Emiliano Medina, o=SOUTH QUALITY, ou=PT SOUTH QUALITY SAS, email=quality@ptsouthquality.com, c=ES 2026.01.12 16:48:22 -03'00'
Sergio Andrada Assistant Technician	**Eng. Alfredo Schmidt** Metallurgical expert	**Eng. Emiliano Medina** Quality Assurance Lead

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1. FOREWORD

This report summarizes the results of the **SQO-M9 (Round 18)** proficiency testing program on the determination of Rockwell C hardness number on metallic materials. This program is carried out under a simultaneous participation format, as described in clause A.2.2 of ISO/IEC 17043: 2023 (Types of PT schemes).

South Quality conducted the testing program from December 2025. The aim of the program was to assess laboratory ability to competently perform the nominated 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 Rockwell C hardness number (HRC) on metallic materials.

This parameter is verified using the following standard:

Standard
ISO 6508-1: 2023

To verify this, batches of metallic samples have been chosen.

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

4. PARTICIPANTS

In the present round, 23 laboratories have participated with the following details:

CODE	Country	ISO 17025 Accredited	Results delivered
01	Argentina	Yes	Yes
02	Belgium	Yes	Yes
03	South Africa	No	Yes
04	Italy	Yes	Yes
05	Pakistan	No	No
06	Hong Kong	Yes	Yes
07	Australia	Yes	Yes
08	Brazil	Yes	Yes
09	Spain	Yes	Yes
10	Colombia	No	No
11	Brazil	No	Yes
12	Netherlands	Yes	Yes
13	England	Yes	Yes
14	Peru	No	Yes
15	Türkiye	Yes	Yes
16.1 + 16.2	France	Yes	Yes
17	Mexico	Yes	Yes
18	Germany	Yes	Yes
19	Portugal	Yes	Yes
20	Chile	No	Yes
21	Malaysia	No	Yes
22	Italy	Yes	Yes
23	Mexico	Yes	Yes

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 the samples were selected using random-number-generation software.

The results of this test are presented below:

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

DETERMINATION	HOMOGENEITY OF RESULTS IN THE ANALYZED SAMPLES (MEDIUM CARBON STEEL)		
	BATCH: LM3260	BATCH: LM3261	BATCH: LM3262
HRC	NO	YES	YES

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

DETERMINATION	HOMOGENEITY OF RESULTS IN THE ANALYZED SAMPLES (LOW CARBON STEEL)		
	BATCH: LM3331	BATCH: LM3332	BATCH: LM3333
HRC	YES	YES	NO

Samples for this program are taken from the selected batches identified as **LM3262** and **LM3332**.

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.

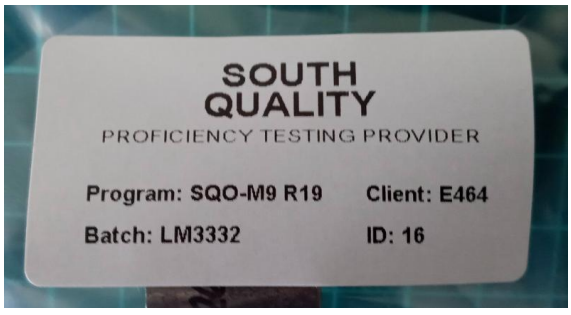
6. SAMPLE INFORMATION

The following samples were sent for testing (Participant **Code 16 - Technician #2**):

Batch:	LM3262
Sample ID:	16
Characteristics:	Medium carbon steel - Ø20 x 20 mm

Batch:	LM3332
Sample ID:	16
Characteristics:	Low carbon steel - 12.7 x 12.7 x 55 mm

7. IMAGES

SAMPLE
         

8. ASSIGNED VALUES

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

9. PARTICIPANT RESULTS

LABORATORY CODE	HRC - AVG	
	LM3262	LM3332
01	22.45	11.39
02	22.87	11.33
03	21.82	11.00
04	21.72	11.45
06	22.03	11.08
07	23.19	11.06
08	21.77	12.01
09	21.91	11.50
11	24.05	12.25
12	22.49	11.33
13	22.34	11.37
14	20.92	10.54
15	21.78	11.56
16.1	22.48	11.18
16.2	22.50	12.18
17	21.80	11.04
18	22.39	11.40
19	23.31	11.45
20	21.87	11.79
21	21.99	12.59
22	22.40	11.41
23	24.66	11.96

PARAMETER	ASSIGNED VALUES			
	LM3262		LM3332	
	MDN	SD	MDN	SD
HRC	22.37	0.74	11.41	0.41

10. STATISTICS

The results must be treated as quantitative.

According to B.4.1.3 of ISO/IEC 17043: 2023, the appropriate technique is to compare participant results with the assigned values.

For quantitative results the comparison is made through z **score** (B.3 - ISO/IEC 17043: 2023).

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

x is the participant's result

X is the assigned value

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

The performance evaluation 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

LABORATORY CODE	|z score|	
	LM3262	LM3332
01	0.1	0.0
02	0.7	0.2
03	0.7	1.0
04	0.9	0.1
06	0.5	0.8
07	1.1	0.8
08	0.8	1.5
09	0.6	0.2
11	2.3	2.1
12	0.2	0.2
13	0.0	0.1
14	2.0	2.1
15	0.8	0.4
16.1	0.2	0.5
16.2	0.2	1.9
17	0.8	0.9
18	0.0	0.0
19	1.3	0.1
20	0.7	0.9
21	0.5	2.9
22	0.0	0.0
23	3.1 ¤	1.4

Laboratory **Code 01**: The laboratory obtained **SATISFACTORY** results for both samples.

Laboratory **Code 02**: The laboratory obtained **SATISFACTORY** results for both samples.

Laboratory **Code 03**: The laboratory obtained **SATISFACTORY** results for both samples.

Laboratory **Code 04**: The laboratory obtained **SATISFACTORY** results for both samples.

Laboratory **Code 05**: The laboratory has not sent the results before the deadline.

Laboratory **Code 06**: The laboratory obtained **SATISFACTORY** results for both samples.

Laboratory **Code 07**: The laboratory obtained **SATISFACTORY** results for both samples.

Laboratory **Code 08**: The laboratory obtained **SATISFACTORY** results for both samples.

Laboratory **Code 09**: The laboratory obtained **SATISFACTORY** results for both samples.

Laboratory **Code 10**: The laboratory has not sent the results before the deadline.

Laboratory **Code 11**: The laboratory obtained **QUESTIONABLE** results for both samples.

Laboratory **Code 12**: The laboratory obtained **SATISFACTORY** results for both samples.

Laboratory **Code 13**: The laboratory obtained **SATISFACTORY** results for both samples.

Laboratory **Code 14**: The laboratory obtained **QUESTIONABLE** results for the **LM3332** sample. However, the results for the **LM3262** sample were **SATISFACTORY**.

Laboratory **Code 15**: The laboratory obtained **SATISFACTORY** results for both samples.

Laboratory **Code 16.1**: Technician #1 obtained **SATISFACTORY** results for both samples.

Laboratory **Code 16.2**: Technician #2 obtained **SATISFACTORY** results for both samples.

Laboratory **Code 17**: The laboratory obtained **SATISFACTORY** results for both samples.

Laboratory **Code 18**: The laboratory obtained **SATISFACTORY** results for both samples.

Laboratory **Code 19**: The laboratory obtained **SATISFACTORY** results for both samples.

Laboratory **Code 20**: The laboratory obtained **SATISFACTORY** results for both samples.

Laboratory **Code 21**: The laboratory obtained **QUESTIONABLE** results for the **LM3332** sample. However, the results for the **LM3262** sample were **SATISFACTORY**.

Laboratory **Code 22**: The laboratory obtained **SATISFACTORY** results for both samples.

Laboratory **Code 23**: The laboratory obtained **UNSATISFACTORY** results for the **LM3262** sample. However, the results for the **LM3332** sample were **SATISFACTORY**.

GLOBAL PERFORMANCE - SUM OF ABSOLUTE Z SCORE

POSITION	LABORATORY CODE	z SCORE
1st	18	0
1st	22	0
2nd	01	0.1
2nd	13	0.1
3rd	12	0.4
4th	16.1	0.7
5th	09	0.8
6th	02	0.9
7th	04	1.0
8th	15	1.2
9th	06	1.3
10th	19	1.4
11th	20	1.6
12th	03	1.7
12th	17	1.7
13th	07	1.9
14th	16.2	2.1
15th	08	2.3
16th	21	3.4
17th	14	4.1
18th	11	4.4

12. CONCLUSIONS

The overall performance on this **SQO-M9 (Round 18)** program from the participating laboratories, based on the expected results, is as follows:

- Laboratories Codes **01, 02, 03, 04, 06, 07, 08, 09, 12, 13, 15, 16.1, 16.2, 17, 18, 19, 20,** and **22** have obtained a **SUFFICIENT** performance in accordance with the expected results and should not take action.

- Laboratories Codes **14,** and **21** have obtained an **ALMOST SUFFICIENT** performance in accordance with the expected results and must evaluate whether corrective action is necessary.

- Laboratories Codes **11,** and **23** have obtained an **INSUFFICIENT** performance in accordance with the expected results and must take corrective action (See Appendix B).

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

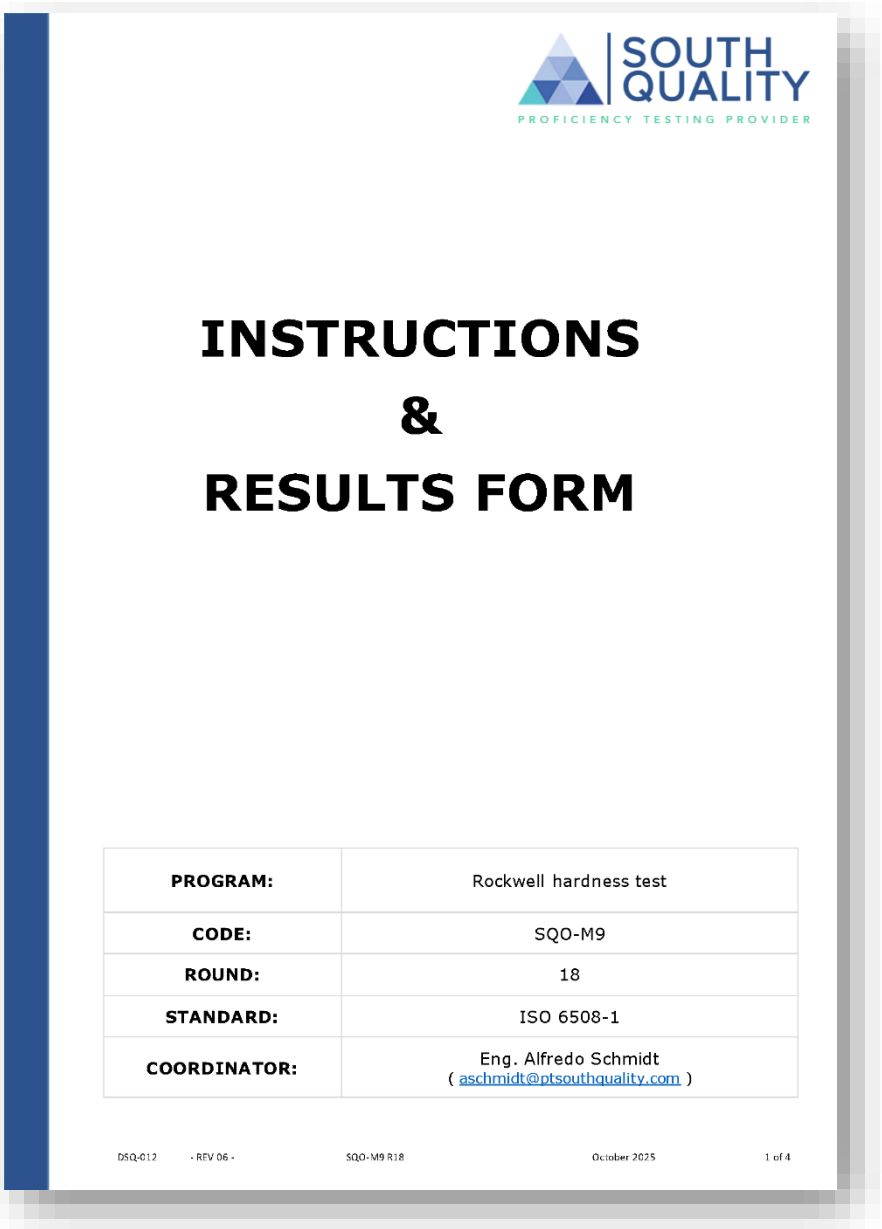
- **SUFFICIENT** performance: No unsatisfactory/questionable results obtained.
- **ALMOST SUFFICIENT** performance: No unsatisfactory results were obtained, but one questionable result was found.
- **INSUFFICIENT** performance: An unsatisfactory result or two questionable results were obtained.

APPENDIX A

A1 - PARTICIPANT DATA

Company:	**BIZLINE**
Laboratory:	**BIZLINE - TECHNICIAN #2**
Country:	France
Client ID:	E464
Contact person:	Ms. Magali Kieloch - Quality Technician
	magali.kieloch@bizline.com

A2 - PARTICIPANT RESULTS



INSTRUCTIONS
&
RESULTS FORM

PROGRAM:	Rockwell hardness test
CODE:	SQO-M9
ROUND:	18
STANDARD:	ISO 6508-1
COORDINATOR:	Eng. Alfredo Schmidt (aschmidt@ptsouthquality.com)

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1 - General

This document is intended to be completed with the results of the **SQO-M9 (Round 18)** program.

Results must be typed, not handwritten.

2 - Standard

ISO 6508-1: 2023

3 - Participant

BIZLINE	CODE 16

4 - Tests involved

TEST
Determination of Rockwell hardness number (HRC)

5 - Samples

CODE	SAMPLE	QUANTITY
LM3262-16	Medium carbon steel - Ø20 x 20 mm	1
LM3332-16	Low carbon steel - 12.7 x 12.7 x 55 mm	1

6 - Notes

a) The deadline for the delivery of results is **December 10, 2025**.
b) The tables in this document may be modified by the participant, if desired, to include data or observations.
c) The samples must be kept until the end of the program, which concludes with the submission of the final report.
d) The samples are to be handled as routine lab samples, with all testing, documentation, and reporting adhering to ISO 6508-1.
e) Participants may improve the sample surface for better testing; if modifications are made, please provide details in the observations box.
f) In sample code **LM3262**-XX, indentations may be made on either side.
g) In sample code **LM3332**-XX, indentations must be made on the **side opposite** to the marked identification.
h) 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.
i) Upon completion of this document, please convert it to a PDF file and send it to the program coordinator.

7 - Test results

Test date:	09/12/2025	**Temperature:**	24°C
Equipment:	PGI001R	**Date calibration:**	09/12/2025
Resolution:	0,1	**Resolution uncertainty:**	0,1

SAMPLE	MEASUREMENT No	RESULT HRC Side two
LM3262-16	1	22,6
	2	22,0
	3	23,0
	4	22,2
	5	22,8
	AVG	22,50
	Expanded uncertainty (U), K=2	0,37

SAMPLE	MEASUREMENT No	RESULT HRC
LM3332-16	1	12,3
	2	12,6
	3	12,1
	4	12,1
	5	11,8
	AVG	12,18
	Expanded uncertainty (U), K=2	0,26

OBSERVATIONS
We carried out those tests with two technicians, one is a new arrival at our laboratory. We send you both measurements with technician 1 and 2 (for reference). PGI 001 R was calibrated in July 2025 at different references (according to our using) 26,6 HRC, 40,9 HRC, 62,7 HRC and 68,5 HRC. Before using, we verify that the durometer meets the requirements using a calibration block. (supplier Foundrax, hardness = 59,49 HRC, serial number: FXR-01742,). The samples were polished with discs having different grits (P320 and P120) with the addition of cold water.

PHOTOGRAPHS

Sample LM3362-16

Sample LM3332.16

APPENDIX B

VOID

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