

REPORT No 11671

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Status: FINAL REPORT

ISO 9227

SALT SPRAY TEST

Neutral Salt Spray (NSS)

Program: SQO-M1 Round 15

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Prepared by:	Reviewed by:	Approved by:
Mateo Giovanni Assistant Technician	Eng. Erika Brest Chemistry expert	Eng. Emiliano Medina Quality Assurance Lead

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1. FOREWORD

This report summarizes the results of the **SQO-M1 (Round 15)** proficiency testing program on the determination of corrosion resistance of 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 February to April 2026. 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
 Statistics: Lic. Manuel Tozaki
 Supervision: Eng. Emiliano Medina

3. OBJECTIVE

The objective of this proficiency testing program is to determine corrosion resistance of metallic materials using the following standard:

Standard
ISO 9227: 2022 + AMD 1: 2024 Neutral Salt Spray (NSS)

To verify this, batches of metallic sheets and bolts have been chosen.

Participants in this program have not been previously informed of the time or time range for the appearance of the first signs of corrosion, nor of the expected mass change of the samples they receive.

As part of the standard practice in this program, three types of shipments are sent to participants during the annual rounds, which may take the following form:

- i. Sample A (Corrosion-resistant) + Sample B (Corrosion-resistant).
- ii. Sample A (Corrosion-resistant) + Sample B (Corrosion-susceptible).
- iii. Sample A (Corrosion-susceptible) + Sample B (Corrosion-susceptible).

4. PARTICIPANTS

In the present round, 22 laboratories have participated with the following details:

CODE	Country	ISO 17025 accredited	Results delivered
01	Malaysia	Yes	Yes
02	Argentina	Yes	No
03	Germany	Yes	Yes
04	South Africa	No	Yes
05	Italy	Yes	Yes
06	Vietnam	Yes	No
07	Hong Kong	Yes	Yes
08	Australia	Yes	Yes
09	Japan	Yes	Yes
10	Colombia	Yes	Yes
11	Spain	Yes	Yes
12	Netherlands	Yes	No
13	Spain	No	Yes
14	Germany	Yes	Yes
15	France	Yes	Yes
16	Peru	No	Yes
17	France	Yes	Yes
18	Chile	Yes	Yes
19	Belgium	Yes	Yes
20	Romania	Yes	Yes
21	Brazil	No	Yes
22	England	Yes	No

5. HOMOGENEITY

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

Then, a homogeneity study was carried out, verifying the time elapsed to the **first sign of corrosion (FSC)** and the **change in mass**, with an ISO/IEC 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 appear below:

Size of each batch: **100 samples**

Tested samples from each batch: **20 samples**

DETERMINATION	HOMOGENEITY OF RESULTS IN THE ANALYZED SAMPLES - STEEL SHEET -		
	BATCH: LM3512	BATCH: LM3513	BATCH: LM3514
FSC	YES	YES	YES
Change in mass	YES	YES	YES

DETERMINATION	HOMOGENEITY OF RESULTS IN THE ANALYZED SAMPLES - BOLTS -		
	BATCH: LM3720	BATCH: LM3721	BATCH: LM3722
FSC	NO	YES	YES
Change in mass	NO	YES	YES

Samples for this program are taken from selected batches identified as **LM3514** and **LM3721**.

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 16**):

Batch:	LM3514
Sample ID:	02 + 66 + 71
Characteristics:	Steel sheet (SAE 1010) - 150 x 100 x 0.7 mm

Batch:	LM3721
Sample ID:	16
Characteristics:	Steel bolt (Metallic coated) - 5/16" x 2 1/4" - 5 units

7. IMAGES



8. ASSIGNED VALUES

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

9. PARTICIPANTS RESULTS

LABORATORY CODE	LM3514			LM3721		
	SAMPLE	FSC - AVG (h)	CHANGE IN MASS AVG (g/m ²)	SAMPLE	FSC - AVG (h)	CHANGE IN MASS AVG (%)
01	26 + 39 + 67	24	-23.45	01	24	-0.60
03	30 + 45 + 77	24	-26.45	03	48	-0.65
04	10 + 41 + 96	24	-19.25	04	48	-0.44
05	05 + 61 + 97	24	-21.56	05	36	-0.31
07	24 + 37 + 91	24	-26.02	07	20	-0.39
08	19 + 35 + 68	24	-20.98	08	24	-0.75
09	04 + 47 + 79	24	-21.09	09	30	-0.32
10	28 + 64 + 69	48	-18.75	10	72	-0.28
11	31 + 48 + 100	24	-19.80	11	18	-0.38
13	32 + 57 + 83	24	-23.12	13	24	-0.49
14	23 + 52 + 70	24	-21.21	14	48	-0.56
15	11 + 59 + 88	24	-25.03	15	24	-0.54
16	02 + 66 + 71	24	-36.80	16	82	-0.58
17	16 + 44 + 84	24	-24.12	17	22	-0.34
18	22 + 36 + 80	24	-16.32	18	48	-0.06
19	25 + 38 + 82	6	-20.96	19	19	-
20	12 + 51 + 98	-	-22.08	20	-	-0.56
21	09 + 62 + 73	25	57.44	21	25	0.28

ASSIGNED VALUES			
PROPERTY	LM3514	PROPERTY	LM3721
FSC (h):	24	FSC (h):	25
CHANGE IN MASS (g/m ²):	-21.39	CHANGE IN MASS (%):	-0.44
CHANGE IN MASS (SD):	3.98	CHANGE IN MASS (SD):	0.22

10. STATISTICS

The results must be treated as qualitative and quantitative.

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

a) For the variable **FSC** the comparison is made through the difference **D** (B.1 – ISO/IEC 17043: 2023).

$$D = (x - X)$$

x is the participant's result

X is the assigned value

The performance evaluation is carried out with the following criteria:

$|D| \leq 12$ h indicates “satisfactory” performance and generates no signal;

12 h < **$|D| \leq 24$ h indicates “questionable” performance and generates a warning signal;**

$|D| > 24$ h indicates “unsatisfactory” performance and generates an action signal;

In those samples where there is no degradation of the material, the result is treated as qualitative and must match with the assigned value to be considered **satisfactory**, otherwise, it is evaluated as **unsatisfactory**.

b) For the variable **CHANGE IN MASS** 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	LM3514		LM3721	
	FSC - AVG (h / Unaffected)	D	FSC - AVG (h / Unaffected)	D
01	24	0	24	1
03	24	0	36	11
04	24	0	48	23
05	24	0	36	11
07	24	0	20	5
08	24	0	24	1
09	24	0	30	5
10	48	24	72	47
11	24	0	18	7
13	24	0	24	1
14	24	0	48	23
15	24	0	24	1
16	24	0	82	57
17	24	0	22	3
18	24	0	48	23
19	6	18	19	6
20	-	-	-	-
21	25	1	25	0

LABORATORY CODE	LM3514		LM3721	
	CHANGE IN MASS - AVG (g/m ²)	z score	CHANGE IN MASS - AVG (%)	z score
01	-23.45	0.5	-0.60	0.7
03	-26.45	1.3	-0.65	1.0
04	-19.25	0.5	-0.44	0
05	-21.56	0	-0.31	0.6
07	-26.02	1.2	-0.39	0.2
08	-20.98	0.1	-0.75	1.4
09	-21.09	0.1	-0.32	0.5
10	-18.75	0.7	-0.28	0.7
11	-19.80	0.4	-0.38	0.3
13	-23.12	0.4	-0.49	0.2
14	-21.21	0	-0.56	0.5
15	-25.03	0.9	-0.54	0.5
16	-36.80	3.9	-0.58	0.6
17	-24.12	0.7	-0.34	0.5
18	-16.32	1.3	-0.06	1.7
19	-20.96	0.1	-	-
20	-22.08	0.2	-0.56	0.5
21	57.44	19.8	0.28	3.3

Laboratory Code 01: The laboratory obtained **SATISFACTORY** results in the determination of all parameters.

Laboratory Code 02: The laboratory did not submit the results before the deadline.

Laboratory Code 03: The laboratory obtained **SATISFACTORY** results in the determination of all parameters.

Laboratory Code 04: The laboratory obtained **QUESTIONABLE** results in the determination of FSC for the LM3721 batch; however, the results for the remaining parameters were **SATISFACTORY**.

Laboratory Code 05: The laboratory obtained **SATISFACTORY** results in the determination of all parameters.

Laboratory Code 06: The laboratory did not submit the results before the deadline.

Laboratory Code 07: The laboratory obtained **SATISFACTORY** results in the determination of all parameters.

Laboratory Code 08: The laboratory obtained **SATISFACTORY** results in the determination of all parameters.

Laboratory Code 09: The laboratory obtained **SATISFACTORY** results in the determination of all parameters.

Laboratory Code 10: The laboratory obtained **QUESTIONABLE** results in the determination of FSC for the LM3514 batch and **UNSATISFACTORY** results in the determination of FSC for the LM3721 batch; however, the results for the change in mass were **SATISFACTORY**.

Laboratory Code 11: The laboratory obtained **SATISFACTORY** results in the determination of all parameters.

Laboratory Code 12: The laboratory did not submit the results before the deadline.

Laboratory Code 13: The laboratory obtained **SATISFACTORY** results in the determination of all parameters.

Laboratory Code 14: The laboratory obtained **QUESTIONABLE** results in the determination of FSC for the LM3721 batch; however, the results for the remaining parameters were **SATISFACTORY**.

Laboratory Code 15: The laboratory obtained **SATISFACTORY** results in the determination of all parameters.

Laboratory Code 16: The laboratory obtained **UNSATISFACTORY** results in the determination of change in mass for the LM3514 batch and **UNSATISFACTORY** results in the determination of FSC for the LM3721 batch; however, the results for the remaining parameters were **SATISFACTORY**.

Laboratory Code 17: The laboratory obtained **SATISFACTORY** results in the determination of all parameters.

Laboratory Code 18: The laboratory obtained **QUESTIONABLE** results in the determination of FSC for the LM3721 batch; however, the results for the remaining parameters were **SATISFACTORY**.

Laboratory Code 19: The laboratory obtained **QUESTIONABLE** results in the determination of FSC for the LM3514 batch; however, the results for the remaining parameters were **SATISFACTORY**, except for the change in mass of the LM3721 batch, which was not reported.

Laboratory Code 20: The laboratory obtained **SATISFACTORY** results in the determination of change in mass for both batches; however, FSC results were not reported because this parameter is not determined in their laboratory.

Laboratory Code 21: The laboratory obtained **UNSATISFACTORY** results in the determination of change in mass for both batches (LM3514 and LM3721); however, the results for FSC were **SATISFACTORY**.

Laboratory Code 22: The laboratory did not submit the results before the deadline.

12. CONCLUSIONS

The overall performance on this **SQO-M1 (Round 15)** program from the participating laboratories, based on expected results, are the following:

- Laboratory Codes **01, 03, 05, 07, 08, 09, 11, 13, 15, 17,** and **20** have obtained a **SUFFICIENT** performance in accordance with the expected results and should not take action;
- Laboratory Codes **04, 14, 18,** and **19** have obtained an **ALMOST SUFFICIENT** performance in accordance with the expected results and must evaluate whether corrective action is necessary;
- Laboratory Codes **10, 16** and **21** 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 as follows:

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

APPENDIX A

A1 - PARTICIPANT DATA

Company: **Instituto de Corrosión y Protección de la Pontificia Universidad Católica del Perú**

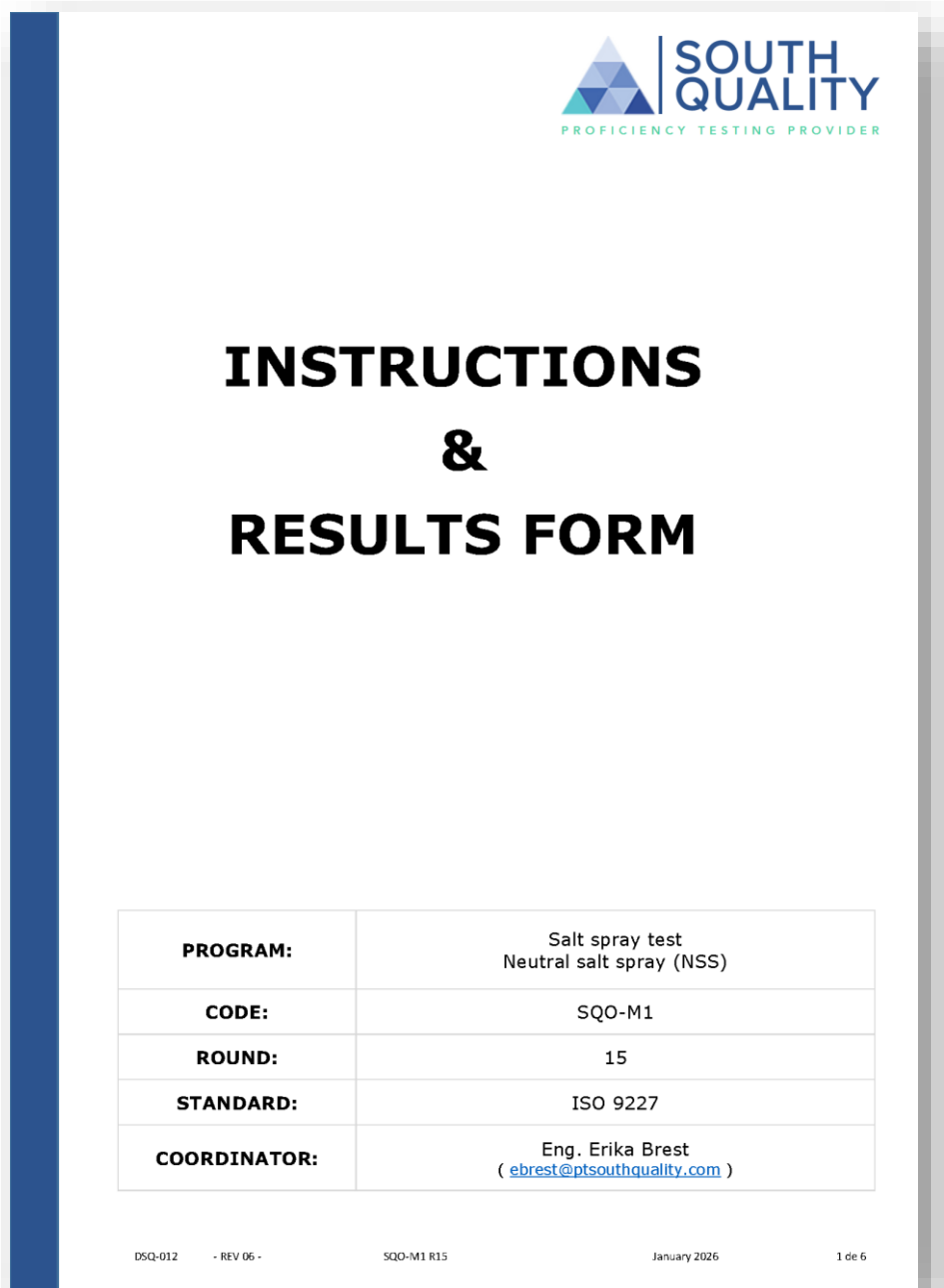
Laboratory: **Laboratorio de Recubrimientos y Corrosión Acelerada**

Country: Perú

Client ID: C121

Contact person: Oscar Miguel Chumpitaz Ramírez - Jefe de Laboratorio
 (ochumpi@pucp.pe)

A2 - PARTICIPANT RESULTS



PROGRAM:	Salt spray test Neutral salt spray (NSS)
CODE:	SQO-M1
ROUND:	15
STANDARD:	ISO 9227
COORDINATOR:	Eng. Erika Brest (ebrest@ptsouthquality.com)

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1 - General

This document is intended to be filled with the results of the **SQO-M1 (Round 15)** program.

Results must be typed, not handwritten.

2 - Standard

ISO 9227: 2022 + AMD1: 2024

3 - Participant

Instituto de Corrosión y Protección de la Pontificia Universidad Católica del Perú Laboratorio de Recubrimientos y Corrosión Acelerada	CODE 16
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4 - Tests involved

TEST
Assessment of corrosion resistance of metallic materials

5 - Samples

CODE	CHARACTERISTICS	QUANTITY
LM3514-XX	Metallic coated sheet - 150 x 100 x 0.7 mm	3
LM3721-16	Steel bolt (Metallic coated) - 5/16" x 2 1/4 "	5

6 - Notes

- a) The deadline for the delivery of results is **March 20, 2026**
- 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 9227**.
- e) Samples **LM3514-XX** are identified on their back side.
- f) 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.
- g) Upon completion of this document, please convert it to a PDF file and send it to the program coordinator.

7 - Preparation of tests specimens

A) Samples shall be properly cleaned, ensuring they are not recontaminated after cleaning due to excessive or careless handling.

B) **(For LM3514-XX samples only)** - Weigh the samples to the nearest 1 mg (**m1**).

C) **(For LM3514-XX samples only)** - The back side and cut edges must be adequately protected by coating them with a suitable material that remains stable under test conditions, such as paint, wax, or adhesive tape. The protective edges on the front face must be straight and parallel to the sample edges, leaving a rectangular area of the material exposed.

D) **(For LM3514-XX samples only)** - Determine the exposed material area (**A**) in cm².

8 - Test conditions

Procedure:	According to standard
Duration of test:	168 h
Inspection frequency:	24 h
Parameter to determine:	First sign of corrosion (FSC) - Red or with rust
Final measurement:	Weigh the specimens to the nearest 1 mg (m2), without protective coatings

9 - Test results

ID	A (cm ²)	m1 (mg)	m2 (mg)	FSC (h)
LM3514-02	110	82815	79037	24
LM3514-66	110	81116	76896	24
LM3514-71	107	80912	76878	24

ID	SAMPLE	m1 (mg)	m2 (mg)	FSC (h)
LM3721-16	I	23923	23759	72
	II	23804	23682	96
	III	23850	23701	72
	IV	23796	23663	72
	V	23835	23724	96

10 - Information and observations (According Clause 14.2)

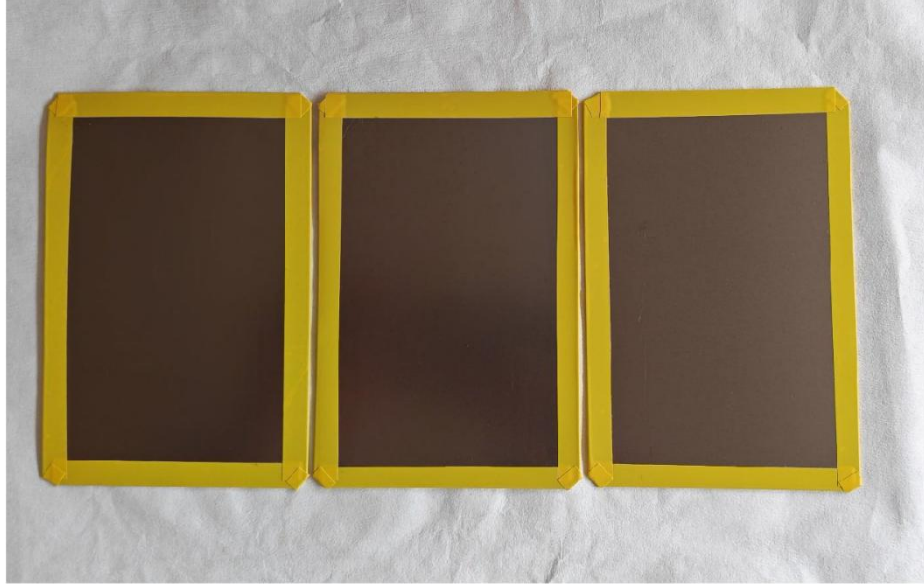
Cl.	Information
b)	
e)	
h)	
i)	
m)	
n)	
o)	
p)	
r)	
s)	

OBSERVATIONS
<p>Hemos tenido problemas con nuestra cámara de niebla salina pero de todas maneras hemos querido participar. Adicionalmente, anteriormente hemos participado en PTs pero de solo 4 días en donde el trabajo de decapado es menos exigente pero a la vez este es más interesante por ese mismo motivo. Además, participando podremos saber en qué debemos incidir a futuro.</p>

PHOTOGRAPHS

Las fotografías están colocadas en el orden de izquierda a derecho para el número de muestra según entregadas. Las fotografías fueron tomadas 3 días después de terminado el ensayo.

ANTES



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DESPUÉS



APPENDIX B

FINDINGS

When an interlaboratory comparison is conducted, findings are derived from the evaluation of practices, procedures, and results reported by all participating laboratories.

Any identified differences in the application of the test method may be documented in this report.

Where unsatisfactory or discrepant results are identified, participating laboratories are expected to address the relevant areas for improvement to ensure compliance with the applicable standard (ISO 9227) and to maintain the reliability of future results.

Laboratories are therefore requested to implement appropriate corrective actions to enhance their performance in subsequent rounds.

The following differences were observed for participant **code 16**:

Clause	Laboratory CODE 16	Most participants ^(*)
14.2	A comparison could not be performed as the laboratory did not complete the information table	-

^(*) Participants with insufficient performance are excluded from the evaluation.

The findings described above refer exclusively to observed differences among the results submitted by participants. They do not imply, in any way, that the participant's result is directly attributable to these differences.

The participant is expected to conduct an internal analysis of any deviations that may have occurred during testing and to take appropriate corrective measures.

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