SOUTH QUALITY

PROFICIENCY TESTING PROVIDER

REPORT No 11671

Date of issue: *April 22, 2026*

Status: FINAL REPORT

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ISO 9227

SALT SPRAY TEST

Neutral Salt Spray (NSS)

Program: SQO-M1 Round 15

****

Prepared by:	Reviewed by:	Approved by:
cn=Mateo Giovanni, o=PT SOUTH QUALITY SAS, ou=SOUTH QUALITY, email=tech@ptsouthquality.com, c=AR 2026.04.22 11:47:43 -03'00'	cn=ERIKA BREST, o=PT SOUTH QUALITY SAS, ou=SOUTH QUALITY, email=ebrest@ptsouthquality.com, c=AR 2026.04.23 09:58:46 -03'00'	cn=Emiliano Medina, o=SOUTH QUALITY, ou=PT SOUTH QUALITY SAS, email=quality@ptsouthquality.com, c=ES 2026.04.23 13:40:59 -03'00'
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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

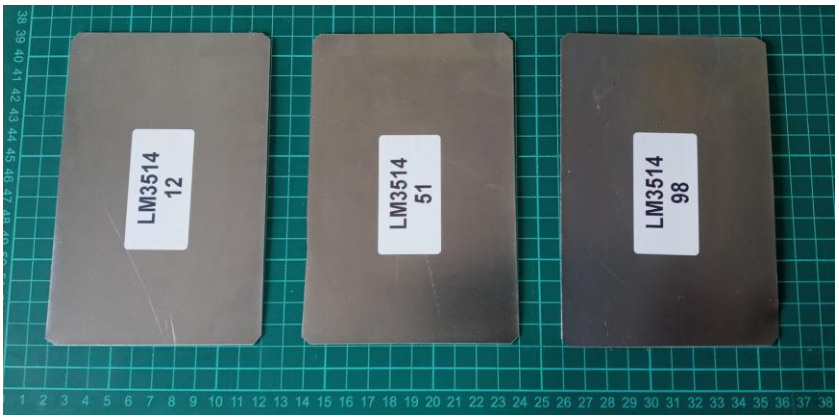
The following samples were sent for testing (Participant **Code 20**):

Batch:	LM3514
Sample ID:	12 + 51 + 98
Characteristics:	Steel sheet (SAE 1010) - 150 x 100 x 0.7 mm

Batch:	LM3721
Sample ID:	20
Characteristics:	Steel bolt (Metallic coated) - 5/16” x 2 1/4” - 5 units

7. IMAGES

SAMPLES



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/m²)	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/m²):	-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:

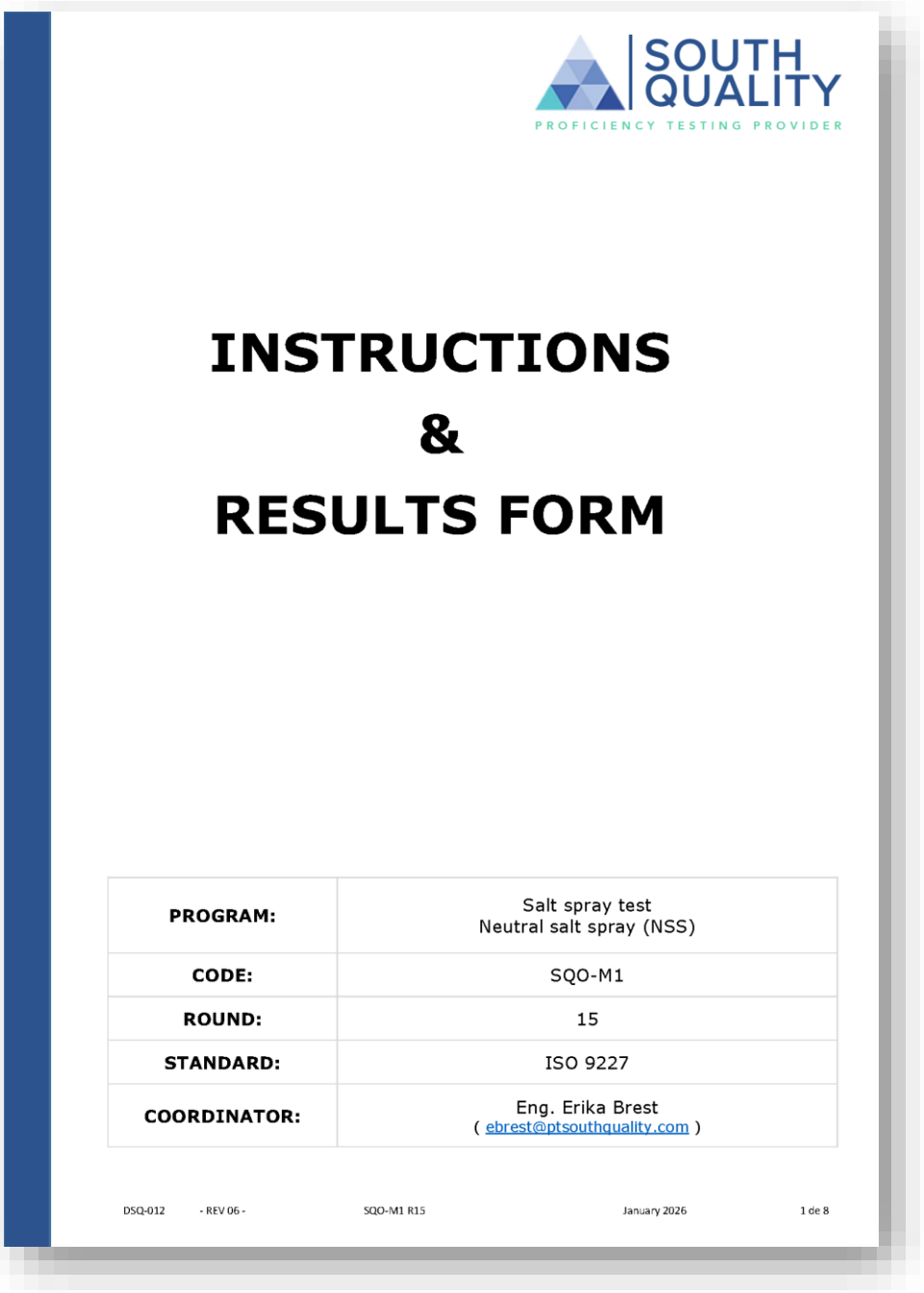
- **SUFFICIENT** performance: No unsatisfactory or questionable results were obtained.
- **ALMOST SUFFICIENT** performance: No unsatisfactory results were obtained, but one questionable result was found.
- **INSUFFICIENT** performance: At least one unsatisfactory result or two questionable results were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

APPENDIX A

A1 - PARTICIPANT DATA

Company:	**Robert Bosch SRL**
Laboratory:	**Engineering Cross Function**
Country:	Romania
Client ID:	E501
Contact person:	Bogdan Valcan - Quality Responsible (bogdan.valcan@ro.bosch.com)

A2 - PARTICIPANT RESULTS



SOUTH QUALITY
PROFICIENCY TESTING PROVIDER

INSTRUCTIONS
&
RESULTS FORM

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

DSQ-012 - REV 06 - SQO-M1 R15 January 2026 1 de 8

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

ROBERT BOSCH SRL Engineering Cross Function	**CODE 20**

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 cm^2.

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)
LM3514-12	150.9916	82310.6	78968.0
LM3514-51	148.9056	81158.0	77850.3
LM3514-98	149.9727	79299.5	76017.3

ID	SAMPLE	m1 (mg)	m2 (mg)
LM3721-20	**I**	23935.9	23802.3
	II	23890.4	23756.0
	III	23930.9	23808.6
	IV	23880.8	23760.2
	V	23849.6	23704.4

10 - **Information and observations (According Clause 14.2)**

Cl.	Information
b)	Type and purity of salt and water used: Sodium chloride Ph. Eur./USP, 99.9%; deionized water: 3-4 µS/cm
e)	Preparation of the test specimen, including any cleaning treatment applied and any protection given to edges or other special areas: 1. Prior to the test, the surfaces of test specimen were cleaned with wipes containing 70% isopropanol and 30% deionized water, and, after wiping, the samples were dried under a stream of compressed air. 2. After cleaning, the samples length and width were measured with a digital caliper and weighed with an analytical balance. The next step was to cover one of their surfaces with adhesive plastic film, and the edges of the steel plates were covered with paint using a paint marker (see Figure 1).
h)	Method used to clean test specimens after the test with, where appropriate, an indication of the loss in mass resulting from the cleaning operation: 1. When the test was finished, the test chamber was opened and the samples were removed from the chamber and rinsed with running tap water, the adhesive plastic film was removed, then the sample was dried under a stream of compressed air at an overpressure not exceeding 200 kPa from approximatively 30 mm. 2. The samples were cleaned by the chemical method described in ISO 9227, Chapter 7.4 – using a solution of 20% di-Ammonium hydrogen citrate and water. Each of the metallic coated sheet and steel bolt were kept in the solution for 10 minutes, then rinsed with water and dried under a stream of compressed air at an overpressure not exceeding 200 kPa from approximatively 30 mm. After cleaning, the samples were weighed (see Figure 3).
i)	Angle at which the tested surfaces were inclined: The plates were placed on special plastic supports to achieve 20° ± 5° vertical tilting (see Figure 2).
m)	Test temperature: 35 ± 2 °C (see Figure 4)
n)	Volume of collected solution: Average collection rate (ml/h): 1.49
o)	pH of the test solution and the collected solution: Test solution: 6.86 Collected solution: 6.81
p)	Salt concentration or density of the collected solution: 5.2%
r)	Any deviations or incident occurring during the entire test procedure: N/A
s)	Intervals of inspection: N/A

OBSERVATIONS

A 24h trial run was performed prior to the test, in order to assess the following characteristics, required by ISO 9227, Chapter 10:
Salt Spray conditions:

Parameters	Standard Values	Measured Values
Salt spray chamber temperature	35 ± 2°C	Conform
Conductivity of the deionized water	≤ 20 µS/cm	3.34 µS/cm
Average collected salt mist at 80 cm^2 area	1.5 ± 0.5 ml/h	1.49 ml/h
Concentration of salt water in tank (mass fraction)	50 g/l ± 5 g/l	52 g/l
Concentration of collected salt mist (mass fraction)	50 g/l ± 5 g/l	52 g/l
pH of the salt water in tank	6.5 -7.2 units	6.86 units
pH of the collected salt mist	6.5 – 7.2 units	6.81 units

The First Sign of Corrosion (FSC) parameter was not determined as this verification is outside the scope of our standard testing procedures. This was confirmed with the program coordinator prior to the commencement of testing.

PHOTOGRAPHS

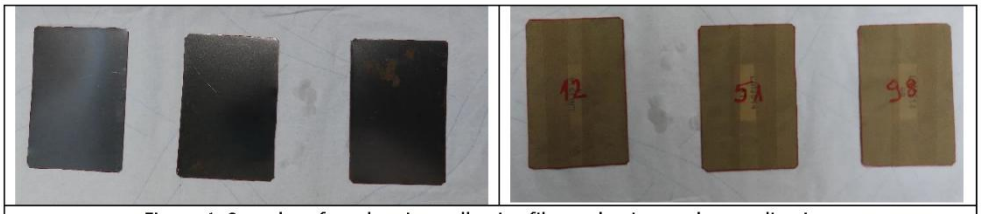


Figure 1. Samples after cleaning, adhesive film and paint marker application.

Figure 2. Samples setup before and after test.

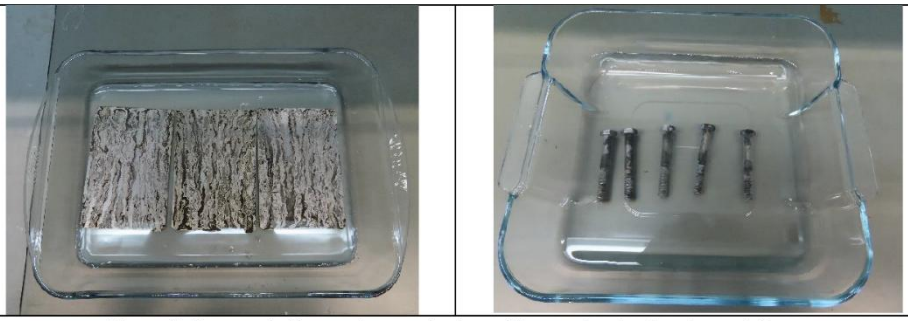
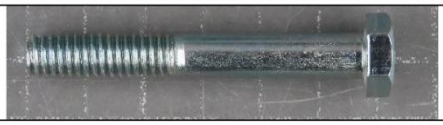
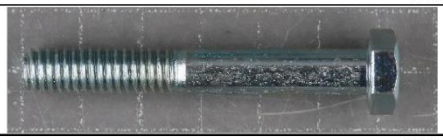
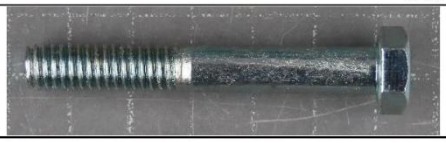
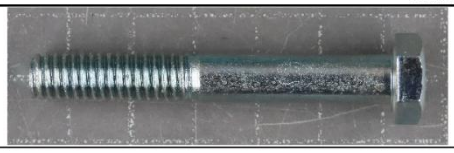
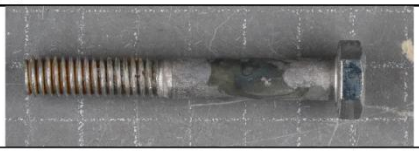


Figure 3. Removal of corrosion products and immersion in cleaning solution.

Before NSS test	After cleaning
LM3514-12	

LM3514-51	
	
LM3514-98	
	
LM3721-20 I	
	
LM3721-20 II	
	
LM3721-20 III	
	
LM3721-20 IV	
	

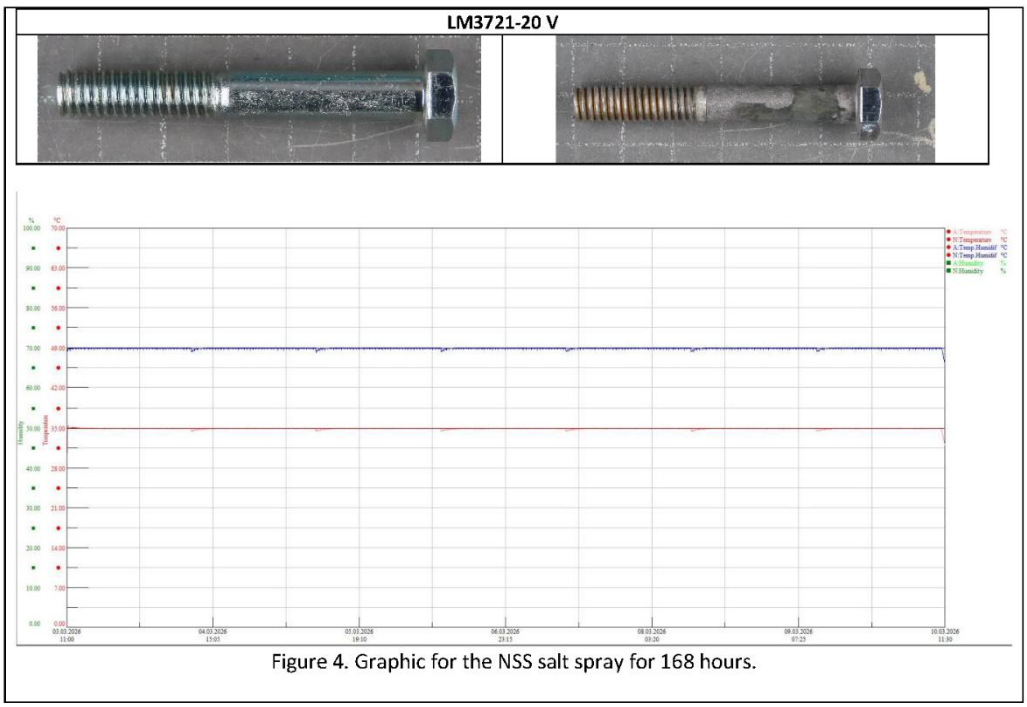


Figure 4. Graphic for the NSS salt spray for 168 hours.

APPENDIX B

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