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Corrosion test Nordtest NT MAT 003

Commission

Determination of corrosion resistance in accordance with NORDTEST – method NT MAT 003 (2002) with the following methods:

- Cyclic corrosion test according to SS-EN ISO 11997-1:2018 Cycle B
- ISO 8407:2021
- Visual evaluation according to ISO 10289:2001

Coating thickness according to SS-EN ISO 1463:2021.

Test objects

The details are presented in the Table 1. All information regarding the coating is given by the customer.

Table 1. *Information on coated screws.*

Receival date at RISE	October 23, 2023
Coating name	PJNCOAT (one batch)
Number of screws for Corrosion test	20 psc
Number of screws for coating thickness	20 psc

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Performance

Coating thickness

Table 2. *Test information to SS-EN ISO 1463:2021.*

Method	SS-EN ISO 1463:2021
Identity of the test specimen	PJNCOAT (one batch) 20 screws
Location of the cross-section	The head of the screw
Date of test	February 14, 2024
Equipment	Microscope no. 401155 with calibration scale no. 402400.
Operator	Per Bochart

Corrosion resistance evaluation

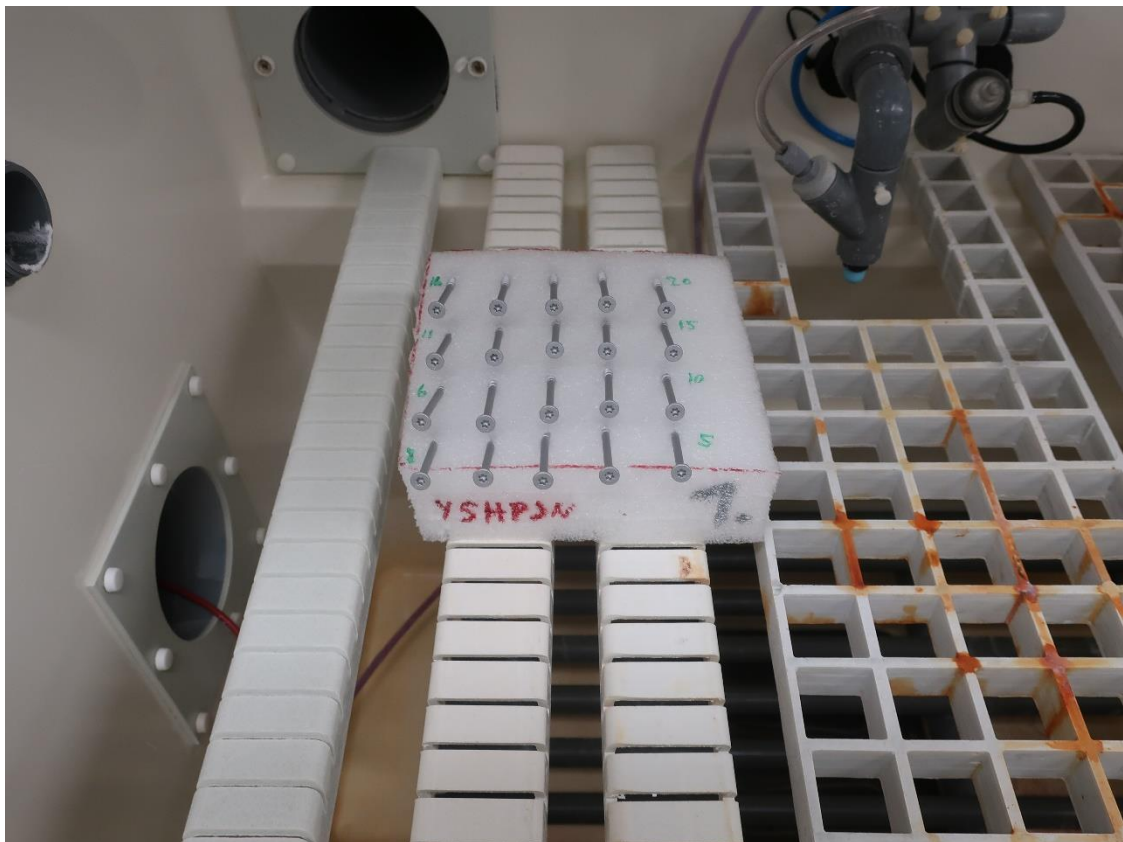


Figure 1. Test objects before exposure in the test chamber.

Table 4. Test information to ISO 11997-1:2018 Cycle B.

Exposure cycle	ISO 11997-1:2018 Cycle B
Exposure time	November 29, 2023 - February 28, 2024
Position of test objects and reference panels	20±5° to the vertical plane
Test duration	13 weeks
Pickling of reference panels	February 27 – February 28, 2024
Test chamber	Ascott 2 450L
Inventory number	BX43841
Place of exposure	Product Durability, Brinellgatan 4, Borås
Test engineers	Bernt Steurer-Andersson

Deviations

No deviations were noted during the salt spray phase

The steps of preparation of reference specimens differs from the described method. The end step was 9 µm, same as prescribed by the method

Result

Coating thickness

In the Table 5 the results can be seen. The average and standard deviation values for the zinc and topcoat layers can be seen in Table 6.

The results are arithmetic mean values of measurements at 5 different points on each screw. In which, the measuring accuracy is ± 0,8 µm.

The reported uncertainty of the measurement is an expanded uncertainty (U), which is based on a standard uncertainty multiplied by a coverage factor, k = 2, providing a level of confidence of approximately 95%. The uncertainty of measurement applies for a single measured value. The spread in results due to variations in the sample characteristics is not accounted for in the report uncertainty of measurement.

Table 5. *Test results from thickness measurements*

Object	Coating thickness, mean value [µm]		Max value [µm]		Min value [µm]		Standard dev. [µm]	
	Layer 1	Layer 2	Layer 1	Layer 2	Layer 1	Layer 2	Layer 1	Layer 2
1	11,1	25,7	12,4	29,7	9,4	19,7	1,0	3,7
2	10,7	29,5	11,3	36,8	10,0	20,9	0,4	5,6
3	11,1	32,4	11,9	39,8	9,6	25,3	0,8	5,1
4	10,8	26,9	11,9	28,5	9,7	24,7	0,7	1,3
5	10,8	26,6	11,6	29,9	9,4	22,2	0,7	2,8
6	10,9	22,7	11,3	27,8	10,3	18,2	0,3	4,1
7	10,6	24,7	12,4	34,3	9,1	17,3	1,0	5,7
8	10,0	27,0	11,3	40,2	8,8	19,6	0,8	8,0
9	11,2	22,8	12,2	25,0	10,4	19,2	0,6	1,9
10	10,2	23,7	11,3	31,3	9,1	20,8	0,7	4,0
11	11,5	23,6	12,2	28,2	10,1	19,3	0,6	3,3
12	10,7	20,8	11,8	22,5	9,3	19,2	0,9	1,1
13	10,9	20,7	12,2	25,4	9,1	18,2	1,1	2,6
14	10,5	28,1	11,2	30,9	9,5	23,4	0,5	2,4
15	10,7	22,2	12,0	26,5	10,0	17,3	0,7	3,8
16	12,2	22,2	19,2	25,4	9,3	18,4	3,7	2,7
17	10,0	20,2	10,7	28,4	9,1	15,1	0,5	4,5
18	11,0	31,2	13,2	48,1	9,8	23,9	1,2	9,2
19	10,3	22,1	10,8	26,1	9,7	20,3	0,4	2,0
20	11,3	26,9	12,3	31,2	10,4	22,0	0,7	3,5

Table 6. *Mean values and standard deviations of the measured coating thicknesses for each layer for all samples.*

Layer	Mean value of measured coating thickness [µm]	Standard deviation (n = 20)
1	10,8	0,51
2	25,0	3,4

Corrosion resistance evaluation

Using the results of the reference panels of zinc and carbon steel, the relationship between corrosivity class and exposure according to ISO 11997-1:2018 Cycle B was calculated. The results are shown in Table 7.

Table 7. Metal loss of zinc and carbon steel according to the testing time according to ISO 11997-1:2018 Cycle B and the corrosivity class based on a technical life-time of 15 years.

Testing time (cycles)	Zinc		Steel		Corrosivity class, mean value
	Metal loss (μm)	C-class	Metal loss (μm)	C-class	
0	0	-	0	-	-
2	13,8	2,5	37,8	1,3	1,9
5	34,5	3,8	94,5	1,9	2,8
8	55,2	4,4	151,2	2,4	3,4
12	82,8	5,0	226,8	3,1	4,0

Table 8. Requirements for different corrosivity classes according to ISO 11997-1:2018 Cycle B based on a technical life-time of 15 years.

Corrosivity class	Testing time according to ISO 11997-1 Cycle B (test cycles of one week)
C1	$0,6 \leq t < 2,2$
C2	$2,2 \leq t < 5,8$
C3	$5,8 \leq t < 11,7$
C4	$t \geq 11,7$

Assessment of the corrosivity class

During the corrosion test, the test areas of the samples were visually examined every week with respect to base metal corrosion. The degree of base metal corrosion was assessed according to the standard SS-EN ISO 10289:2001 by giving a grade between 0 and 10 to each sample. The testing time when more than 10 % of the samples exhibited base metal corrosion (grade 9, i.e. between 0 and 0.1 % of the surface area was corroded) was assessed by interpolation.

According to the requirements of the method sample PJNCOAT is approved for corrosivity class C4 and the corrosivity class based on a technical life-time of 15 years.

All PJNCOAT coated screws have maintained their integrity until week 13 of testing.

Comments and restrictions

The results in this report concern only the tested products. The test method does not include damage to the products that may arise during installation in the field (in actual use).

Accelerated corrosion testing is not an exact model of long-term exposure in the field. However, cyclic corrosion tests (like ISO 11997-1:2018 Cycle B) correlate much better with real exposure than tests with continuous salt spray.

Table A.1 and A.2 in the NORDTEST-method NT MAT 003 (2002) are revised in accordance to the new values for metal loss in the latest version of ISO 9224:2012.

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Performed by

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Verification

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Nordtest NT MAT 003**
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