

Specification

Zinc Flake Coating

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Version: E

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Change History

| Version | Date | Reason of Change | Chapter/Page(s) |
|---------|------------|--|--|
| - | 05.04.2017 | Creation | all |
| A | 18.06.2018 | Correction of standards Contacts changed Added list of approved coating systems | |
| B | 29.10.2018 | Siemens AG changed to Siemens Mobility GmbH Qualification test revised: Chap. 8.1 „test samples“ added (was Chap. 8) Chap. 8.2 „qualification tests to be carried out“ added (was Chap. 8) and Table 6 revised Chap. 8.3 „testing institute and test report“ added (was Chap. 8) Chap. 8.4 was Chap. 8.1 Chap. 8.5 was Chap. 8.2 Chap. 8.6 „separation resistance“ added Chap. 8.7 „verification of screw handling“ added Chap. 8.8 was Chap. 8.3, breakdown into sub chapters 8.8.1 und 8.8.2 Chap. 8.9 was Chap. 8.4 | all Chap. 8.1 Chap. 8.2 Chap. 8.3 Chap. 8.4 Chap. 8.5 Chap. 8.6 Chap. 8.7 Chap. 8.8 Chap. 8.9 |
| C | 14.03.2019 | Chap. 8.3 „test report by an accredited test institute (DIN EN ISO 17025)“ added Screw handling expanded Chap. 8.9 „verification of Friction Values expanded“ | Chap. 8.3 Chap. 5.3 Chap. 8.9 |
| D | 10.06.2020 | Telephone number changed Atotech coating systems added to list of approved coating systems | Chap. 2 Chap. 7 |
| E | 23.11.2021 | Thread size \geq M20 changed to $>$ M16 Delta Protekt KL 120 + Delta Protekt VH 301.1 GZ added Supplier changed to Dörken Coatings GmbH & Co. KG Smallest total layer thickness deleted from Table 5 and Table 6 Reference to Table 2 and Table 4 added | Kap. 5 Kap. 7 |

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1 Area of Application

This specification defines the requirements for zinc flake coatings for steel components with thread and non-threaded steel components.

2 Contact

Table 1 Contacts

| Siemens Mobility GmbH, Engineering | |
|---|---|
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3 Normative Requirements

The coating must be carried out according to the following standards:

- DIN EN ISO 10683: Fasteners- Non-electrolytically applied zinc flake coating systems
- DIN EN 13858: Corrosion protection of metals - Non-electrolytically applied zinc flake coatings on iron or steel components

4 Coating System

Zinc flake coating systems must always be implemented as a 2-layer structure containing a zinc flake basecoat and a topcoat. A coating without topcoat is not permitted. Unless specified otherwise, the color of the coating is silver-grey.

This specification differentiates between coating systems

- For connecting elements (Chapter 5: Screws, nuts, washers, sliding blocks)
- For components without thread (Chapter 6: Holders, supplements, expansion sleeves)

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5 Coating of Connection Elements

Table 2 Coating of Connection Elements with Threads

| Application | Standard Designation of the Coating | Smallest total local layer thickness | Friction Value |
|--|-------------------------------------|--------------------------------------|-----------------|
| Screws and components with thread \leq M16 | ISO 10683 – flZn/nc/TL/480h/C | 5 μm | C = 0,09 – 0,14 |
| Screws and components with thread $>$ M16 | ISO 10683 – flZn/nc/TL/720h/C | 8 μm | C = 0,09 – 0,14 |
| Explanation of the designations after ISO 10683: flZn: Zinc flakes nc: Chrome IV free TL: Topcoat with integrated lubricant e.g. 480 h: Resistance to salt spray test 480 hours C: Friction value μ | | | |

5.1 Friction Value

The coatings used must have a friction value range of $\mu = 0,09 - 0,14$.

5.2 Corrosion Resistance

The resistance in the salt spray test must at least reach the values specified in chapter 8.8.2, Table 8.

5.3 Screw Handling

Coated screws with an ISO-screw thread of tolerance class g6 must fit in a gauge or an uncoated slot nut of tolerance class H6. For parts with an internal thread of tolerance class H6, the screw handling must be tested with a gauge of tolerance class g6 or a screw without coating or a zinc, zinc-nickel or zinc-flake coating. To ensure an easy installation of the screw-connection a maximum torque of $0.001 \times d^3$ (Nm) is allowed. The variable d stands for the thread-diameter in millimeters.

Table 3 Examples of Maximum Torque

| Thread Diameter d in mm | Maximum Torque in Nm |
|-------------------------|----------------------|
| 8 | 0,51 |
| 10 | 1,0 |
| 12 | 1,7 |
| 16 | 4,1 |
| 20 | 8,0 |

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6 Coating of Threadless Components

Table 4 Coating of Threadless Components

| Application | Standard Designation of the Coating | Smallest total local layer thickness | Friction Value |
|--|-------------------------------------|--------------------------------------|----------------|
| Threadless components, e.g. expansion sleeves, holder | EN 13858 - Fe/flZn8/nc/T2 | 8 µm | >0,18 |
| Fe: Base metal flZn: Zinc flakes z.B. 8: Minimum thickness 8µm nc: Chrome IV free T2: Sealing with Topcoat | | | |

6.1 Friction Value

The applied coatings must have a friction coefficient of $\mu \geq 0,18$.

6.2 Resistance against Corrosion

The resistance in the salt spray test must reach at least the specified values listed in chapter 8.8.2, Table 8.

7 Approved Coating Systems

Components for Siemens Mobility GmbH may only be coated with approved zinc flake systems.

The following steps are required for the approval of a coating system:

- Implementation of the qualification tests according to chapter 8.
- Submission of a test report according to chapter 8.3 to the contact.

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Table 5 Approved Zinc Flake Coating Systems for the Coating of Connection Elements (Screws, Disks, Sliding blocks)

| Coating System | Supplier |
|--|-------------------------------|
| Geomet 321A Plus VL | NOF Metal Coatings |
| Geomet 321B Plus VL | NOF Metal Coatings |
| Zintek ONE HP + Zintek Top LV <i>or</i> XT | Atotech GmbH |
| Zintek 200 + Zintek Top LV <i>or</i> XT | Atotech GmbH |
| Delta Protekt KL 100 <i>or</i> 120 + Delta Protekt VH 301 GZ | Dörken Coatings GmbH & Co. KG |
| Delta Protekt KL 120 + Delta Protekt VH 301.1 GZ | Dörken Coatings GmbH & Co. KG |
| Remcor Base Silver 50 + Remcor Aqua Seal 805 L | Rembrandtin Lack GmbH |

When choosing the total layer thickness the application from Table 2 must be considered.

Table 6 Approved Zinc Flake Coating Systems for Coating of Threadless Components (Holders, Washers, Expansion sleeves)

| Coating System | Supplier |
|--|-------------------------------|
| Geomet 321B Plus 10 | NOF Metal Coatings |
| Zintek ONE HP + Zintek Top | Atotech GmbH |
| Zintek 200 + Zintek Top | Atotech GmbH |
| Delta Protekt KL100 <i>or</i> 120 + Delta Protekt VH 300 | Dörken Coatings GmbH & Co. KG |
| Remcor Base Silver 50 + Remcor Aqua Seal 804 | Rembrandtin Lack GmbH |

When choosing the total layer thickness the application from Table 4 must be considered.

8 Qualification Tests for Zinc Flake Coatings

These tests are only necessary for the qualification of a new zinc flake coating system.

8.1 Test Samples

The qualification tests are carried out on first samples or test sheets.

First samples are identical to series production parts. This means:

- Same material,
- Same geometry,
- Same surface pre-treatment,
- Same coating material and
- Same coating process for first article and series production part.

The following applies to test sheets:

- Material: S355 or S235 to EN 10025-2
- Dimensions: about 100 x 100 mm, thickness approx. 3 mm

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- Same surface pre-treatment,
- Same coating material and
- Same coating process for test sheet and series production part.

8.2 Qualification Tests to be Carried out and Number of Test Samples

The test samples shall be tested in accordance with Table 1.

Table 7 Qualification Tests and Number of Test Samples

| Test | Visual component inspection | Measuring the coat thickness | Adhesive strength test | Verification of screw handling | Cathodic protection | Corrosion protection | Verification of friction values |
|-----------------------|-----------------------------|------------------------------|------------------------|--------------------------------|---------------------|----------------------|---------------------------------|
| Chapter | 8.4 | 8.5 | 8.6 | 8.7 | 8.8.1 | 8.8.2 | 8.9 |
| Connection elements | All samples | All samples | 3 samples | 3 samples | 3 samples | 3 samples | 10 or 20 samples |
| Threadless components | All samples | All samples | 3 samples | - | 3 samples | 3 samples | - |

8.3 Testing Institute and Test Report

The qualification tests need to be carried out by an accredited test institute (DIN EN ISO 17025) and shall be documented in a test report.

The test report must include the following data in particular:

- Date
- Performing institution (independent, accredited)
- Performing person
- Component designation (A2V no. if first articles are used)
- Documentation of the test results.

The test report and the tested first articles / test sheets must be presented to the person in charge of corrosion protection. The person in charge of corrosion protection approves the coating company by entering it into the list of approved coating companies (chapter 7 of this document).

8.4 Visual Component Inspection

The visual component inspection must be carried out on all first articles for components with thread and without thread.

- Unless noted otherwise, all surfaces must be completely coated.
- Unless noted otherwise, holes/bores and notches must be completely coated.
- The coating must be silver-grey-colored and smooth and uniform.
- The coating must adhere to the substrate and may not contain any blister.
- Spalling, defects and damages that are visible without optical devices are not permitted.

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8.5 Verification of the Coating Thickness

The verification of the coating thickness must be conducted for threaded and non-threaded components on all first samples. If the sample is too small, the verification of the coating thickness must be conducted with three test sheets.

Unless otherwise agreed, coating thickness measuring is conducted with a magnetic induction method according to ISO 2178.

The local coating thickness equals the arithmetic mean of five individual measurements of the coating thickness conducted on the same surface. The total coating thickness includes basecoat and topcoat.

The local minimum coating thickness of all samples / test sheets must at least reach demanded values of Table 2 and Table 4.

Unless otherwise agreed reference surface according to DIN EN ISO 10683 (cap. 7.3, picture 2) must be used for connecting elements.

If it is not possible to scale five measurements due to surface dimensions, five samples are required for determination of the local coating thickness respectively.

8.6 Separation Resistance

Connecting elements:

- Verification of the separation resistance on Screws, screw nuts and disk testing is not possible. The tests must therefore be conducted on three test sheets instead of screws, screw nuts and spinner.
- Non-threaded components and slot nut

The testing is being done on three samples and must be conducted on an eligible component surface.

A textile tape stripe (see EN 60454-2) is tightly pressed on cleaned and defatted surface, e.g. 100mm length and 25mm width. The force needed to detach the tape from the test sheet must at least reach 3,5N/10mm.

After five minutes the textile tape is removed as fast as possible under a 180° angle. The testing must be conducted at $(20 \pm 5) ^\circ\text{C}$.

There may no indication of flaking of the plating's surface. Cohesive flaking may not be declared as failure.

Annotation:

Coating material which is visible at the component's surface as well as on the tape usually is a result of cohesion deficits. Visible base metal and coating material at the tape typically results from a deficit of bond.

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8.7 Verification of Screw Handling

Crew handling of threaded components must be tested as described in chapter 5.3 on three first samples. The maximum torque according to chapter 5.3, Table 3 may not be exceeded by any sample.

8.8 Corrosion Tests

8.8.1 Cathodic Protection

The cathodic protection must be proven on three samples with a neutral salt spray test according to ISO 9227. If the samples are too small for testing, the verification must be conducted on test sheets.

The samples must be cut by a tool within a nominal width 0.5mm up to the basis metal. After salt spray test with a duration of 72 hours there may be no red rust at and around the scratch.

8.8.2 Corrosion Protection

The corrosion protection must be proven on three samples with a neutral salt spray test according to ISO 9227.

The samples must last for a minimum duration according to Table 8 depending on the layer thickness without forming of red rust.

(For determination of minimal local total coating thickness see chapter 10)

Table 8 Claimed Minimum Resistance Depending on Layer Thickness

| Duration of the salt spray test (without red rust) | Minimum local layer thickness |
|---|-------------------------------|
| 480 h | 5 µm |
| 720 h | 8 µm |

8.9 Verification of Friction Values

Connecting parts (screws, nuts, disks and slot nuts) must maintain a friction coefficient of $\mu = 0.09$ to 0.14 . Verification of this characteristic must be performed with the following test

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Table 9 Verification of the Friction Coefficient

| Verification of the Friction Coefficient for Threaded Parts (Verification by Testing Institutes) | |
|--|--|
| Test Samples | 10 first samples |
| | Description |
| | <ul style="list-style-type: none"> 10 screws M10x50 DIN EN ISO 4017 10 disks ISO 7089 - 10 - 200 HV 10 nuts EN ISO 4032 M10 or threaded plates M10 |
| | Conditioning for 14 days at standard climatic conditions |
| Test | Determination of the total friction coefficient μ_{tot} according to DIN EN ISO 16047 chapter 10.2. |
| Requirements | The range of the friction coefficient must be $0,14 \geq \mu \geq 0,09$ for all test samples. |

9 Applicable Documents

Table 2: Applicable Documents

| | |
|------------------|---|
| DIN EN ISO 10683 | Fasteners - Non-electrolytically applied zinc flake coatings |
| DIN EN 13858 | Corrosion protection of metals - Non-electrolytically applied zinc flake coatings on iron or steel components |
| DIN EN ISO 16047 | Fasteners - Torque/clamp force testing |
| ISO 2178 | Non-magnetic coatings on magnetic substrates - Measurement of coating thickness - Magnetic method |
| ISO 1502 | ISO general-purpose metric screw threads - Gauges and gauging |