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**Fasteners - Non-electrolytically applied zinc flake coatings
(English Translation)**

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Table of Contents

Foreword...	4
Introduction...	7
1 Scope...	8
2 Normative references...	8
3 Terms and definitions...	9
4 General characteristics of coatings...	9
4.1 Zinc flake coating system...	9
4.2 Composition of zinc flake coating systems...	10
4.3 Mechanical properties, physical properties, curing...	10
4.4 Avoiding internal hydrogen embrittlement...	10
4.5 Coating systems and coating processes...	11
5 Corrosion resistance and testing...	11
5.1 General requirements...	11
5.2 Neutral salt spray test...	11
5.3 Sulfur dioxide test (Kesternich test)...	12
5.4 Automated bulk handling and conveying and/or sorting, storage and transportation ...	13
6 Dimensional requirements and tests...	13
6.1 General requirements...	13
6.2 ISO metric thread fasteners...	13
6.3 Other fasteners...	15
7 Mechanical, physical properties and tests...	15
7.1 Appearance...	15
7.2 Corrosion resistance as a function of temperature...	15
7.3 Test method for thickness or coating quality.....	15
7.4 Ductility...	17
7.5 Adhesion/bonding...	17
7.6 Sacrificial cathodic protection...	17
7.7 Torque-clamping force relationship.....	17
7.8 Determination of hexavalent chromium...	18
8 Adaptability test...	18
8.1 General requirements...	18
8.2 Mandatory tests for each batch of products...	18

8.3 Process control tests...	18
8.4 Tests specified by the user...	19
9 Marking...	19
9.1 Marking of zinc flake coating system...	19

1 Scope

This document specifies the technical requirements for non-electrolytically applied zinc flake coatings on steel fasteners.

This document applies to the following coatings:

- With or without hexavalent chromium;
- With or without topcoat;
- With or without lubrication (self-lubricating and/or additional lubrication).

This document applies to ISO metric threaded bolts, screws, studs, nuts, non-ISO metric threaded fasteners, unthreaded fasteners such as washers, pins, clamps, etc.

This document does not specify the weldability or coating performance of fasteners and is not applicable to mechanical galvanizing.

Note: High-strength fasteners (tensile strength ≥ 1000 MPa) use coatings that comply with this document to avoid the risk of internal hydrogen embrittlement (see 4.4).

For information on the design and installation of coated fasteners, see Appendix A.

2 Normative references

The contents of the following documents constitute essential provisions of this document through normative references in the text. Among them, for referenced documents with dates, only the version corresponding to that date applies to this document; for referenced documents without dates, the latest version (including all amendments) applies to this document.

GB/T 1237 Designation system for fasteners (GB/T 1237-2000, eqv ISO 8991:1986)

GB/T 3099.3 Terminology of fasteners - Coatings (GB/T 3099.3-2017, ISO 1891-2:2014, MOD)

GB/T 3934 Specification of gauges for general purpose screw threads (GB/T 3934-2003, ISO 1502:1996, MOD)

GB/T 6462 Metallic and oxide coatings - Measurement of coating thickness -

Microscopical method (GB/T 6462-2005, ISO 1463:2003, IDT)

GB/T 9789 Metallic and other non-organic coatings - Sulfur dioxide test with general condensation of moisture (GB/T 9789-2008, ISO 6988:1985, IDT)

GB/T 10125 Corrosion tests in artificial atmospheres - Salt spray tests (GB/T 10125-2021, ISO 9227:2017, MOD)

GB/T 16823.3 Fasteners - Torque/clamp force testing (GB/T 16823.3-2010, ISO 16047:2005, IDT)

ISO 3613:2010 Metallic and other inorganic coatings - Chromate conversion coatings on zinc, cadmium, aluminium-zinc alloys and zinc-aluminium alloys - Test methods

Note: GB/T 9791-2003 Chromate conversion coatings on zinc, cadmium, aluminium-zinc alloys and zinc-aluminium alloys - Test methods (ISO 3613:2000, MOD).

3 Terms and definitions

The terms and definitions defined in GB/T 3099.3 apply to this document.

4.1 Zinc flake coating system

A non-electrolytically applied zinc flake coating system is formed, by applying zinc flakes to the surface of steel fasteners by adding flake aluminum in a suitable medium.

Under the action of heat curing, the zinc flakes are bonded to each other and to the substrate to form an inorganic topcoat, which has good conductivity and cathodic protection. The coating may contain hexavalent chromium.

Measures shall be taken to avoid excessive or insufficient thickness of coating.

Measures shall be taken to avoid light and/or flat fasteners from being bonded together (e.g. washers, clamps, fastener assemblies, flange nuts).

Additional topcoats can improve corrosion resistance and/or achieve specific functions (e.g., torque-clamping force performance, chemical resistance, appearance, color, electrical insulation/conductivity, see A.2).

Pretreatment processes using alkaline/solvent cleaning followed by mechanical cleaning do not generate hydrogen, thus eliminating all risk of internal hydrogen embrittlement (IHE).

When the functional properties are not suitable for mechanical cleaning (e.g., fastener assemblies, internally threaded fasteners, oiled fasteners), chemical cleaning (pickling) may be used, using acids with appropriate corrosion inhibitors and the shortest cleaning cycles to minimize the risk of internal hydrogen embrittlement. Fasteners with hardness above 390

HV or property class 12.9 or above shall not be pickled; the time interval between cleaning and coating shall be as short as possible.

Phosphating can be an alternative to mechanical cleaning (hydrogen may be generated during pretreatment, but hydrogen can diffuse outward during curing). The time interval between phosphating and coating shall be as short as possible.

Electrolytic cleaning shall not be performed.

Note: Zinc flake coatings are highly permeable to hydrogen; hydrogen absorbed during pretreatment can diffuse outward during curing.

4.5 Coating systems and coating processes

When selecting a coating system and the associated coating process, the type and geometry of the fastener shall be considered, see A.2.

5.1 General requirements

The corrosion resistance measured by the accelerated corrosion test has no direct correspondence with the corrosion resistance characteristics in a specific service environment; however, the accelerated corrosion test is used to evaluate the corrosion resistance of the coating.

Note: Appendix B gives a guide for selecting the thickness of the corrosion-resistant coating.

5.2 Neutral salt spray test

The neutral salt spray test (NSS) in accordance with GB/T 10125 is used to evaluate the corrosion resistance of the coating system.

When the salt spray test chamber is required to be evaluated, it should refer to Appendix C.

5.4 Automated bulk handling and conveying and/or sorting, storage

and transportation

Automated bulk handling and conveying and/or sorting, storage and transportation may cause a significant reduction in the corrosion protection of the coating, depending on the type and geometry of the coating system and the fastener. This may especially occur in chromium-free (hexavalent) coating systems with poor self-healing properties and/or topcoats that are sensitive to impact damage and/or abrasion.

If necessary, a supply and demand agreement shall be signed to determine the minimum cycle of the neutral salt spray test and/or increase the thickness of the coating system.