DRAFT INTERNATIONAL STANDARD ISO/DIS 10683

ISO/TC **2**/SC **14** Secretariat: **DIN**

Voting begins on **2011-03-24** Voting terminates on **2011-08-24**

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION • МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ • ORGANISATION INTERNATIONALE DE NORMALISATION

Fasteners — Non-electrolytically applied zinc flake coatings

Éléments de fixation — Revêtements non électrolytiques de zinc lamellaire

[Revision of first edition (ISO 10683:2000)]

ICS 21.060.01; 25.220.40

ISO/CEN PARALLEL PROCESSING

This draft has been developed within the International Organization for Standardization (ISO), and processed under the **ISO-lead** mode of collaboration as defined in the Vienna Agreement.

This draft is hereby submitted to the ISO member bodies and to the CEN member bodies for a parallel five-month enquiry.

Should this draft be accepted, a final draft, established on the basis of comments received, will be submitted to a parallel two-month approval vote in ISO and formal vote in CEN.

To expedite distribution, this document is circulated as received from the committee secretariat. ISO Central Secretariat work of editing and text composition will be undertaken at publication stage.

Pour accélérer la distribution, le présent document est distribué tel qu'il est parvenu du secrétariat du comité. Le travail de rédaction et de composition de texte sera effectué au Secrétariat central de l'ISO au stade de publication.

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 10683 was prepared by Technical Committee ISO/TC 2, *Fasteners*, Subcommittee SC 1, and by Technical Committee CEN/TC 185, *Fasteners* in collaboration.

This second/third/... edition cancels and replaces the first/second/... edition (ISO 10683:2000), [clause(s) / subclause(s) / table(s) / figure(s) / annex(es)] of which [has / have] been technically revised.

Introduction

The revision of this International Standard was made in order to define the relevant requirements on zinc flake coated fasteners (coating systems with and without chromate) for all parties involved in the fastener field, i.e. chemical suppliers, coaters, fastener manufacturers, distributors and end users. It covers all types of fasteners, i.e. fasteners with ISO metric thread, fasteners with non-ISO metric thread (including thread forming, ASME inch 60° screw thread, etc.) and non-threaded fasteners (including washers, pins, clips, etc.). It also provides basic advices for the design and use of coated fasteners in assembly.

Fasteners — Non-electrolytically applied zinc flake coatings

1 Scope

This International Standard specifies requirements for non-electrolytically applied zinc flake coatings for steel fasteners. It applies to coatings:

— with or without chromate,

— with or without top coat,

— with or without lubricant (integral lubricant and/or subsequently added lubricant).

NOTE 1 National regulations for the restriction or prohibition of certain chemical elements should be taken into account in the countries or regions concerned.

It applies to bolts, screws, studs and nuts with ISO metric thread, to fasteners with non-ISO metric thread, and to non-threaded fasteners such as washers, pins and clips.

NOTE 2 Coatings according to this International Standard are especially used for high strength fasteners (> 1000 MPa) to avoid risk of hydrogen embrittlement (see 4.4).

Consideration for design and assembly of coated fasteners are given in Annex A.

This International Standard does not specify requirements for such fasteners properties as weldability or paintability. It does not apply to mechanically applied zinc coatings.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 1463, *Metallic and oxide coatings — Measurement of coating thickness — Microscopical method*

ISO 1502, *ISO general purpose metric screw threads — Gauges and gauging*

ISO 3269, *Fasteners — Acceptance inspection*

ISO 3613:2000, *Chromate conversion coatings on zinc, cadmium, aluminium-zinc alloys and zinc-aluminium alloys — Test methods*

ISO 6988, *Metallic and other non-organic coatings — Sulfur dioxide test with general condensation of moisture*

ISO 8991, *Designation system for fasteners*

ISO 9227:2006, *Corrosion tests in artificial atmospheres — Salt spray tests*

ISO 16047, *Fasteners — Torque/clamp force testing*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/WD *Fasteners – Vocabulary for coatings* (under elaboration) apply.

4 General characteristics of the coating

4.1 Zinc flake coating systems

Zinc flake coating systems are produced by applying to the surface of a steel fastener a zinc flake dispersion, usually with the addition of aluminium flakes, in a suitable medium. Under the influence of heat (curing), a bonding amongst flakes and also between flakes and substrate is generated, thus forming an inorganic surface coating sufficiently electrically conducting to ensure cathodic protection. The coating may or may not contain chromate.

Special techniques can be necessary to avoid excessive or insufficient coating thickness.

Special techniques can be necessary to prevent light weight and/or flat fasteners from sticking together (e.g. washers, clips, fasteners with captive washer, flanged nuts).

An additional top coat can be applied to increase corrosion resistance and/or to achieve specific properties (e.g. torque/tension properties, chemical resistance, aspect, colour, electrical insulation/conductivity).

See A.1.3.

4.2 Composition of the systems

There are four basic zinc flake coating systems, see Figure 1:

— only base coat: 1

— base coat + lubricant: 2

— base coat + top coat: 3

— base coat + top coat + lubricant: 4

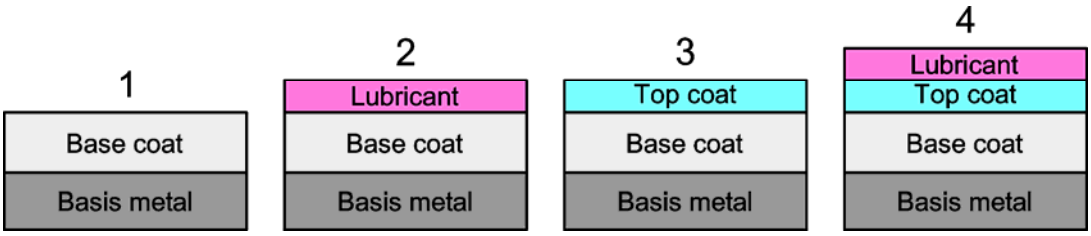

Figure 1 — Basic zinc flake coating systems

Base coat and top coat can be with integral lubricant, see detailed possible combinations in A.1.2.

4.3 Mechanical and physical properties and curing

The coating process shall not adversely influence the mechanical and physical properties of the fasteners.

NOTE Distributors who coat non-coated fasteners are considered as alteration distributors according to ISO 16426.

Depending on the zinc flake coating system the curing temperatures can be up to 320 °C. The curing temperature shall not be above the tempering temperature of quenched and tempered fasteners.

WARNING — The curing process (especially with higher temperature and/or longer duration) may affect the fatigue limit of fasteners with thread rolled after heat treatment. See also A.1.3 for other possible effect of curing.

4.4 Pre-treatment processes and avoidance of hydrogen embrittlement

A characteristic of zinc flake coatings is that hydrogen is not generated.

Fasteners to be coated with zinc flake coating systems shall be cleaned using alkaline cleaner followed by mechanical cleaning. These pre-treatment steps do not generate nascent hydrogen, thus eliminating all risk of hydrogen embrittlement from the pre-treatment process.

When the above pre-treatment is not possible for functional reasons (e.g. for fasteners with captive washers, fasteners with internal threads, fasteners to be rack coated), chemical cleaning (pickling) may be applied, provided that acid with suitable inhibitor and minimum cleaning cycle time are used to minimize the risk of hydrogen embrittlement. The duration between cleaning and coating shall be as short as possible. Cathodic cleaning processes are not permitted.

A suitable phosphating process is permitted as an alternative to chemical cleaning.

NOTE Zinc flake coatings have a high permeability for hydrogen which, during the curing process, allows effusion of hydrogen which may have been absorbed during the pre-treatment process as specified hereabove.

4.5 Coating systems and coating processes

The type and geometry of the fasteners shall be considered when selecting a coating system and the related coating process, see A.2.

5 Corrosion protection and testing

5.1 General

Performance in accelerated corrosion tests (neutral salt spray test, moisture tests, cycling tests, etc.) cannot be directly related to corrosion protection behaviour in particular service environments. However, accelerated tests are used to evaluate the corrosion protection performance of the coating.

5.2 Neutral salt spray test

The neutral salt spray test (NSS) in accordance with ISO 9227:2006, 5.2, is used to evaluate the corrosion resistance of the coating systems. For coated fasteners, the salt spray chamber shall be controlled according to Annex C.

The neutral salt spray test shall be carried out on the fastener at least 24h after coating in the "as-coated" condition, i. e. before sorting and/or packaging.

After the neutral salt spray test using test duration of Table 1 there shall be no visible basis metal corrosion (red rust).

Table 1 — Salt spray test requirements

Salt spray test duration (red rust)	Reference thickness of the coating system[a]
240 h	4 µm
480 h	5 µm
600 h	6 µm
720 h	8 µm
960 h	10 µm

[a] The reference thickness includes base coat(s) and top coat(s) if any, with or without chromate. The corrosion resistance is decisive for acceptance, the reference thickness is given for guidance only.

The composition of the system (base coat only, base coat + top coat, etc.) shall be specified at the time of the order.

NOTE Guidance for the selection of coating thickness in relation to corrosion protection is given in Annex B.

5.3 Sulfur dioxide test

This test is only intended for outdoor building fasteners.

The sulfur dioxide test with general condensation of moisture in accordance with ISO 6988 is used to evaluate the corrosion resistance of the coating systems; for outdoor building fasteners, the test shall be carried out with two litres of SO_2.

The sulfur dioxide test shall be carried out on the fastener at least 24h after coating in the "as-coated" condition, i. e. before sorting and/or packaging.

The minimum number of cycles shall be agreed between the purchaser and the customer at the time of the order i.e. 2 cycles, 3, 5, 8, 10, 12, 15 cycles, etc.

5.4 Bulk handling, automatic processes including feeding and/or sorting, and transport

Bulk handling, automatic processes including feeding and/or sorting, and transport can cause a significant reduction of corrosion protection depending on the coating system and type and geometry of the fasteners. This may especially occurs for Cr(VI)-free coating systems where less self-healing effect takes place and/or where top coats are sensitive to impact damage and abrasion.

When necessary, an agreement should be reached between the supplier and the customer, either reducing the minimum duration to neutral salt spray test and/or increasing the thickness of the coating system.

6 Dimensional requirements and testing

6.1 General

Before coating, fasteners shall be within the specified dimensions. For ISO metric threads special requirements may apply, see 6.2.2, B.4 and B.5.

6.2 Bolts, screws, studs and nuts with ISO metric threads

6.2.1 Coating thickness

When checking the coating thickness related to the desired corrosion resistance, the dispersion of the coating system shall be taken into account, see B.3.

Coating thickness has a significant influence on gaugeability, therefore thread tolerance and clearance in the thread shall be taken into account. The coating shall not cause the zero line (basic size) to be exceeded in the case of external threads; nor shall it fall below in the case of internal threads, see B.4.

NOTE For standard bolts and screws already manufactured, not exceeding the zero line position limits the clearance and may decrease the maximum possible thickness of coating, thus limiting the corrosion resistance, see B.5.

6.2.2 Gaugeability and assemblability

Coated ISO metric screw threads shall be gauged according to ISO 1502 with a GO-gauge of tolerance position h for external threads and H for internal threads.

When gauging a coated external thread, a maximum torque of 0,001 d^3 (Nm) is acceptable, where d is the nominal thread diameter in mm, see Table 2.

Table 2 — Maximum torque for gauging of coated ISO metric screw threads

Nominal thread diameter d mm	Maximum torque for gauging Nm
4	0,07
5	0,13
6	0,22
8	0,51
10	1,00
12	1,73
14	2,7
16	4,1
18	5,8
20	8,0
22	10,6
24	13,8
For other diameters, the torque shall be calculated according to 0,001 d^3 (Nm).	

Other acceptance procedures may be applied by agreement between supplier and purchaser:

— For external thread, use of a suitable nut or the original mating fastener,

— For internal thread, use of a suitable mandrel or the original mating fastener.