BRITISH STANDARD

BS 7371 :
Part 11 : 1993

Coatings on metal fasteners

Part 11. Specification for zinc flake non-electrolytically applied cured coatings

BSI
STANDARDS

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the General Mechanical Engineering Standards Policy Committee (GME/-) to Technical Committee GME/9, upon which the following bodies were represented:

BEAMA Ltd.
British Constructional Steelwork Association Ltd.
British Industrial Fasteners Federation
British Railways Board
British Steel Industry
British Steel Industry (Wire Section)
Gauge and Tool Makers' Association
Society of Motor Manufacturers and Traders Ltd.
Washer Manufacturers' Association of Great Britain

The following bodies were also represented in the drafting of the standard, through subcommittees and panels:

British Turned-parts Manufacturers' Association
Institute of Metal Finishing
Metal Finishing Association
Stainless Steel Fabricators' Association of Great Britain
National Centre of Tribology

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Contents

Foreword

This Part of BS 7371 has been prepared under the authority of the General Mechanical Engineering Standards Policy Committee to provide part of a series of standards on coatings on metal fasteners.

Compliance with a British Standard does not of itself confer immunity from legal obligations

0 Introduction

BS 7371 deals with the performance and selection of coatings on metal fasteners and accessories.

This Part of BS 7371 specifies the requirements for zinc flake non-electrically applied cured coatings.

Other published Parts of BS 7371 are as follows:

BS 7371 : Part 1 : 1991 *Specification for general requirements and selection guidelines*[1)]

BS 7371 : Part 2 : 1993 *Specification for torque/clamping force relationship*

Further Parts of the series to incorporate the following are in preparation:

Specification for electroplated zinc and cadmium coatings

Specification for electroplated nickel, nickel/chromium and copper/nickel/chromium coatings

Specification for electroplated tin and tin/lead coatings

Specification for electroplated coatings for special purposes

Specification for mechanically applied zinc and cadmium coatings

Specification for mechanically applied coatings for special purposes

Specification for phosphate and oil coatings

Specification for organic coatings

Zinc flake based coatings covered by this Part of BS 7371 are for use on fasteners and accessories where the following apply:

a) higher corrosion resistance than is attainable from electroplated or mechanically plated zinc coatings is necessary;

b) avoidance of hydrogen embrittlement is needed;

c) a more even coverage of parts of complex shape than would be obtained by electroplated metallic coatings is advantageous;

d) the absence of white corrosion product formation is beneficial to the appearance of the component;

e) an effective alternative to cadmium coating is necessary.

Additional coatings are available to modify colour but these may influence coating performance, e.g. lubricity or electrical conductivity.

The shape of certain parts may create difficulties in the application of these coatings and reference to the coater is recommended to enquire if a difficulty exists or if it can be overcome by the use of specialized processing methods. Typical difficulties arise with:

1) parts with flat surfaces that may stick together during processing, e.g. flat washers;

2) parts with shapes that induce nesting;

3) parts with recesses.

The coatings are suitable for application to components such as the following:

i) parallel threaded fasteners and accessories;

ii) screws that cut or form their own threads, e.g. self tapping (see for example BS 4174);

iii) woodscrews (see for example BS 1210);

iv) springs and spring components;

v) pipe nuts and connectors with parallel or tapered threads.

When these coatings are applied to non-ferrous base metals the corrosion resistance requirements are not applicable.

The processing temperature of certain coatings conforming to this standard may adversely affect the mechanical properties of some heat treated shot peened or cold work hardened components.

1 Scope

This Part of BS 7371 specifies requirements for non-electrolytically applied coatings which are cured from a zinc flake dispersion in a suitable medium. Hydrogen embrittlement is not induced by the coating process. The final coatings consist principally of zinc and can incorporate an integral lubricant with controlled torque/clamping force properties (see for example BS 7371 : Part 2).

This Part of BS 7371 also specifies requirements for the following:

a) two grades of coating;

b) quality assessment of the corrosion resistance of unused coated parts when subjected to neutral salt spray testing (see for example BS 7479);

c) adhesion test.

2 References

2.1 Normative references

This Part of BS 7371 incorporates, by reference, provisions from specific editions of other publications. These normative references are cited at the appropriate points in the text and the publications are listed on the inside back cover. Subsequent amendments to, or revisions of, any of these publications apply to this Part of BS 7371 only when incorporated in it by updating or revision.

[1)] This is supplementary to all other Parts of BS 7371.

2.2 Informative references

This Part of BS 7371 refers to other publications that provide information or guidance. Editions of these publications current at the time of issue of this standard are listed on the inside back cover, but reference should be made to the latest editions.

3 Definitions

For the purposes of this Part of BS 7371, the definitions given in BS 7371 : Part 1 : 1991 shall apply.

4 Applications and type of coating

4.1 Cleaning and pretreatment

Parts, fasteners and accessories shall be cleaned and pretreated in accordance with clauses **4** and **5** of BS 7371 : Part 1 : 1991.

NOTE. A phosphating pretreatment is permitted to improve adhesion or corrosion resistance, this may reduce the electrical conductivity and parts which have a phosphate pretreatment may require de-embrittlement if the curing temperature of the zinc flake coating does not exceed 180 °C.

4.2 Type of coating

The coating shall be silver grey in appearance and completely dry. Zinc flake shall be the main constituent of the coating.

NOTE 1. The colour may be further modified by the addition of an organic top coat.

The coating shall be electrically conductive (for voltages of 12 V and above) and shall protect steel against corrosion.

Where the lubricity of the zinc coated fastener is to be modified by the incorporation of an additive, e.g. polytetraflouroethane (PTFE), the torque/clamping force performance of a coated fastener shall conform to BS 7371 : Part 2. (See clause **8**.)

NOTE 2. The colour may be modified by the addition of an organic coating which may affect dimensions, lubricity and electrical conductivity.

4.3 Curing

The coating shall be cured and the curing temperature shall not exceed 310 °C.

NOTE. Curing temperatures vary for different proprietory coatings. Lower curing temperatures need to be investigated if a temperature of 310 °C will adversely affect the mechanical or physical properties of the part.

5 Coating

5.1 Surface condition

The coating shall be clean, dry and of uniform appearance. All surfaces of a component shall be coated unless otherwise agreed. The coating shall be free from blisters or loosely adhering material.

5.2 Corrosion resistance

Unless otherwise agreed, representative samples from a batch shall be tested in conformance with clause **7** of BS 7371 : Part 1 : 1991 and shall be tested for resistance to neutral salt spray in accordance with BS 7479 : Part 1 : 1991. Coatings shall be graded by their corrosion resistance as given in table 1. Significant surfaces shall resist neutral salt spray for the time given in table 1. Surfaces which are not significant shall resist neutral salt spray for 50 % of the time given in table 1.

NOTE 1. For routine quality control purposes, after the ability of the coating to conform to the corrosion test is established, evaluation of coating mass or thickness may be used, but for referee purposes the corrosion resistance requirements still apply.

NOTE 2. For guidance purposes only, the following thicknesses or their equivalent coating masses can be expected.

a) For grade A a coating thickness of 5 µm to 10 µm equating to approximately 20 g/m^2.

b) For grade B a coating thickness of 8 µm to 15 µm equating to approximately 30 g/m^2.

NOTE 3. A method for determination of coating masses is given in annex B.

Table 1. Corrosion resistance

Grade	Resistance of neutral salt spray, time for base metal corrosion (min) h
A	240
B	480

NOTE. Both grades are available with controlled lubricity.

5.3 Adhesion

When tested in accordance with annex A the exposure of more than 10 % of the tested area shall constitute failure. Parts which do not have significant surfaces of sufficient size or shape to permit testing in accordance with annex A shall be assessed by testing suitable parts coated by the same process in the same production run.

NOTE. Pick-up of some colouration on the tape is permissible.

6 Gauging after coating for threaded fastener components

After coating, the finished threaded fastener component shall conform to the following.

a) A coated externally threaded component shall assemble into a similarly threaded nut with thread of tolerance class 6H in conformance with Part 2 of BS 3643 : 1981.

b) A coated internally threaded component shall assemble onto a similarly threaded bolt with thread of tolerance class 6h in conformance with Part 2 of BS 3643 : 1981.

NOTE. For the suitability of zinc flake coatings for threaded fasteners see annex C.

7 Information to be supplied

The following information shall be fully documented:

a) the number of this British Standard BS 7371 : Part 11 : 1993[2)];

b) the coating grade;

c) the colour (if silver grey is not required);

d) the requirements of a coating lubricated to BS 7371 : Part 2 : 1993;

e) any additional information regarding limitations of the process to be used, e.g. metallurgical condition details if the curing temperature may have some effect.

8 Identification

The coating shall be identified by the number and part number of this British Standard together with the grade.

The grade shall be selected from table 1.

A colour shall be identified by the colour name after the grade identification.

NOTE. The absence of a colour in the designation signifies the natural colour of the coating (silver grey).

A lubricated condition shall be designated by the letter L after the colour or grade identification as applicable (see **4.2**). (For example, a black zinc flake coating of grade A with integral lubrication will be identified as BS 7371 : Part 11 grade A black L.)

[2)] Marking BS 7371 : Part 11 : 1993 on or in relation to a product represents a manufacturer's declaration of conformity, i.e. a claim by or on behalf of the manufacturer that the product meets the requirements of the standard. The accuracy of the claim is solely the claimant's responsibility. Such a declaration is not to be confused with third party certification of conformity, which may be desirable.

Annexes

Annex A (normative)
Adhesion test

Using a sharp instrument, scribe lines through to the base metal approximately 3 mm apart across a significant surface of the component, then scribe further lines at approximately 90° to these. Apply a strip of clear tape conforming to BS 3887 and rub down with finger pressure. Remove the tape within (90 ± 30) s of application by pulling it off rapidly and smoothly, back upon itself, as closely as possible to an angle of 180° to the coated surface.

Annex B (informative)
Determination of coating mass

B.1 Method

Immerse pre-weighted components, having a minimum surface area of 20 cm^2, in a 20 % sodium hydroxide solution contained in a boiling tube, and place the tube and contents into a beaker of boiling water.

When all chemical reaction has ceased, remove the components and wash them with hot distilled or de-ionized water.

Dry, cool and re-weigh the components.

NOTE. Other reagents may be used for coating removal provided that no base metal is removed and no coating residues remain.

B.2 Calculation

Calculate the coating mass per unit area in g/m^2 from the following formula:

$$\frac{\text{mass of stripped coating in g} \times 10^4}{\text{surface area in cm}^2}$$

NOTE. Surface area tables are given in appendix C of BS 7371 : Part 1 : 1991.

B.3 Phosphate pretreatments

The coating masses of phosphate pretreatments are not included in the coating masses specified in **5.2.**

A method of determination of the coating mass of a phosphate pretreatment is given in BS 5411 : Part 14 : 1982 which is carried out prior to application of the zinc flake coating.

This coating mass should then be subtracted from the coating mass calculated in **B.1** to give the actual mass of the zinc flake coating.

Annex C (informative)
Suitability of zinc flake coatings for threaded fasteners

C.1 General

The suitability of the specified coatings for threaded parts is limited by the clearance between external and internal threads.

Tables C.1, C.2 and C.3 give guidance on the grades of coating that can be applied to standard threads to limit the risk of interference.

C.2 Avoidance of thread interference for threads in conformance with Part 2 of BS 3643

Table C.1 shows grades of coating which may be safely applied to male threaded parts with thread tolerance classes g, f or e, before coating, which are to be mated after coating with uncoated female threads tolerance class H.

Table C.2 shows grades of coating which may be safely applied to female threaded parts with thread tolerance classes H or G, before coating, which are to be mated after coating with uncoated male threads tolerance class g.

Table C.3 shows grades of coatings which may be safely applied if both male and female threaded parts are to be coated.

NOTE. The fundamental deviations for each thread tolerance class are shown in BS 3643 : Part 2.

Table C.1. Zinc flake coatings for male threaded fasteners to be used with tolerance class H threaded female fasteners

Thread pitch	Suitable coating grade		
	Male thread tolerance class g	Male thread tolerance class f	Male thread tolerance class e
mm			
0.35 0.4 0.45 0.5 0.6 0.7	None	A	A or B
0.75 0.8 1 1.25 1.5 1.75	A	A or B	
2 2.5	A or B		

Table C.2. Zinc flake coatings for female threaded fasteners to be used with tolerance class g threaded male fasteners

Thread pitch	Suitable coating grade	
	Female thread tolerance class H	Female thread tolerance class G
mm		
0.35 0.4	None	None
0.45 0.5 0.6 0.7		A
0.75 0.8 1	A	
1.25 1.5 1.75 2 2.5		A or B

Table C.3. Zinc flake coatings for male/female thread combinations

Thread pitch	Suitable coating grade					
mm	g/H	f/H	e/H	g/G	f/G	e/G
0.35 0.4 0.45	None	A	A	A	A or B	A or B
0.5 0.6 0.7 0.75 0.8 1			A or B	A or B		
1.25 1.5 1.75 2 2.5	A	A or B				

List of references (see clause 2)

Normative references

BSI standards publications

BRITISH STANDARDS INSTITUTION, London

BS 3643 :	*ISO metric screw threads*
BS 3643 : Part 2 : 1981	*Specification for selected limits of size*
BS 3887 : 1991	*Specification for pressure sensitive adhesive closing and sealing tapes*
BS 5411 :	*Methods of test for metallic and related coatings*
BS 5411 : Part 14 : 1982	*Gravimetric method for determination of coating mass per unit area of conversion coatings on metallic materials*
BS 7371 :	*Coatings on metal fasteners*
BS 7371 : Part 1 : 1991	*Specification for general requirements and selection guidelines*
BS 7371 : Part 2 : 1993	*Specification for torque/clamping force relationship*
BS 7479 : 1991	*Method for salt spray corrosion tests in artificial atmospheres*

Informative references

BSI standards publications

BRITISH STANDARDS INSTITUTION, London

BS 1210 : 1963[3)]	*Specification for wood screws*
BS 4174 : 1972[3)]	*Specification for self-tapping screws and metallic drive screws*

[3)] Referred to in clause 0 introduction only.

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