BRITISH STANDARD

BS 7371 :
Part 9 : 1996

Coatings on metal fasteners

Part 9. Specification for phosphate or phosphate and oil coatings

ICS 21.060; 25.220

Committees responsible for this British Standard

The preparation of this British Standard was entrusted to Technical Committee FME/9, Bolts, nuts and accessories, upon which the following bodies were represented:

BEAMA Ltd.
British Constructional Steelwork Association Ltd.
British Industrial Fasteners Federation
British Steel Industry
British Steel Industry (Wire Section)
Gauge and Tool Makers' Association
National Association of Fastener Stockholders
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
National Centre of Tribology
Stainless Steel Fabricators' Association of Great Britain

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The following BSI references relate to the work on this standard:
Committee reference FME/9
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Contents

Foreword

This British Standard has been prepared by Technical Committee FME/9 to provide Part of a series of standards on requirements for coatings on metal fasteners.

WARNING. This British Standard calls for the use of substances and/or procedures that may be injurious to health if adequate precautions are not taken. It refers only to technical suitability and does not absolve the user from legal obligations relating to health and safety at any stage.

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

Specification

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 phosphate or phosphate and oil 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*
BS 7371 : Part 3 : 1993	*Specification for electroplated zinc and cadmium coatings*
BS 7371 : Part 4 : 1994	*Specification for electroplated nickel, nickel/chromium and copper/nickel/chromium coatings*
BS 7371 : Part 7 : 1993	*Specification for mechanically applied zinc coatings*
BS 7371 : Part 10 : 1994	*Specification for organic coatings*
BS 7371 : Part 11 : 1993	*Specification for zinc flake non-electrolytically applied cured coatings*

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

Specification for electroplated tin and tin/lead coatings

Specification for electroplated coatings for special purposes

Specification for mechanically applied coatings for special purposes

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

a) a relatively low corrosion resistance can be accepted;

b) a low cost coating with lubricative properties is required, to give a controlled torque/clamping force relationship;

c) the risk of hydrogen embrittlement of high tensile steel fasteners is acceptable, or is minimized by suitable processing (see BS 7371 : Part 1 : 1991 and **5.4** of this standard);

d) an even overall coverage is required;

e) a coating is required as an undercoat to assist adhesion and/or corrosion resistance of an organic type coating (see BS 7371 : Part 10 : 1994).

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

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 which may retain excessive lubricant.

The coatings specified in this standard are suitable for application to metal components such as the following:

i) parallel threaded fasteners and accessories;

ii) screws that cut or form their own threads, e.g. self-tapping screws (see for example BS 4174 : 1972);

iii) woodscrews (see for example BS 1210 : 1963);

iv) springs and spring components;

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

When these coatings are applied to non-ferrous fasteners the corrosion resistance requirements do not apply.

NOTE. The coating processes covered by this standard may induce hydrogen embrittlement in certain ferrous fasteners. Attention is drawn to the appropriate requirements of BS 7371 : Part 1 : 1991.

1 Scope

This Part of BS 7371 specifies requirements for phosphate or phosphate and oil coatings on metal fasteners and accessories, applied by immersion or spraying.

NOTE 1. Phosphate coatings are primarily intended for application to ferrous, zinc or zinc alloy fasteners.

NOTE 2. Phosphate coatings can be used as an undercoat to improve the corrosion resistance and adhesion of a subsequently applied top coat (e.g. organic coating).

NOTE 3. Phosphate coatings can be used to impart a controlled torque/clamping force relationship to a threaded fastener (see BS 7371 : Part 2 : 1993).

This Part of BS 7371 should be read in conjuction with the requirements for phosphate and phosphate and oil coatings of BS 7371 : Part 1 *General requirements and selection guidelines.*

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

a) the minimum coating mass per unit area;

b) assessment of the corrosion resistance of unused coated parts when subjected to neutral salt spray testing (see for example BS 7479 : 1991).

[1)] All other Parts of BS 7371 should be read in conjunction with this Part.

2 References

2.1 Normative references

This Part of BS 7371 incorporates, by dated or undated reference, provisions from other publications. These normative references are made at the appropriate places in the text and the cited publications are listed on the inside back cover. For dated references, only the edition cited applies; any subsequent amendments to or revisions of the cited publication apply to this Part of BS 7371 only when incorporated in the reference by amendment or revision. For undated references, the latest edition of the cited publication applies, together with any amendments.

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 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. Precautions appropriate for the avoidance of hydrogen embrittlement of high tensile parts should be observed.

4.2 Type of coating

The coating shall be matt grey and crystalline in appearance and consist primarily of manganese or zinc phosphate.

4.3 Application

The coating shall be applied to the fastener by either immersion in or spraying with the appropriate solution of manganese or zinc phosphate.

5 Coating

5.1 Surface condition

When supplied unoiled the coating shall be dry and of crystalline appearance.

NOTE. The appearance may vary slightly according to the surface condition of the substrate, even on the same fastener.

Phosphate coatings shall be supplied oiled unless otherwise requested (see clause 8).

NOTE. The oiled coating is dark grey to black and may be visibly oily.

The torque/clamping force performance of a phosphate and oiled coating shall be in accordance with BS 7371 : Part 2 : 1993.

5.2 Classification of coating

Phosphate coatings shall be classified as shown in table 1.

5.3 Minimum coating mass per unit area

The minimum coating mass per unit area shall be as shown in table 1.

NOTE. A suitable method for the determination of coating mass per unit area is given in annex A.

Table 1. Classification of coating and coating mass per unit area

Classification	Coating type	Minimum coating mass per unit area g/m^2
Type 1[1)]	Manganese phosphate	8
Type 2[2)]	Zinc phosphate[3)]	10

[1)] Oiled type 1 coatings are usually used to impart corrosion resistance coupled with a controlled torque/clamping force relationship to a threaded fastener.
[2)] Type 2 coatings may be used as an undercoat for organic coatings (see BS 7371 : Part 10 : 1994).
[3)] Other metal phosphates may be incorporated in the coating, e.g. calcium or iron.

5.4 De-embrittlement process

Fasteners heat treated or cold worked to a surface hardness greater than 320 HV or of property class 9.8[2)] and above which are phosphate coated shall be heat treated within 1 h of the completion of the phosphating process to reduce the risk of embrittlement failure. The heat treatment process shall consist of baking the fastener for min. 1 h at a temperature of between 130 °C and 200 °C. Fasteners shall not be baked at temperatures greater than that at which they were finally tempered during any heat treatment process carried out prior to the phosphating treatment.

NOTE 1. High tensile fasteners with a surface hardness below 390 HV need not have this baking treatment if they are not used until at least 48 h after the completion of the phosphating treatment.

NOTE 2. Although the surface hardness of fasteners of property class 8.8 may marginally exceed 320 HV it is not a requirement of this standard that they should be heat treated subsequent to any phosphating process provided that the surface hardness is not in excess of 350 HV.

NOTE 3. Where any subsequent hardening heat treatment of a phosphate coated fastener is likely to increase the surface hardness above 320 HV, the phosphate coating should be removed prior to the hardening heat treatment process in order to reduce the risk of any resulting embrittlement.

[2)] See BS EN 20898 : Part 1 : 1992 for property classes.

5.5 Corrosion resistance of oiled coated ferrous parts

NOTE. There is no requirement in this standard for the corrosion resistance of unoiled phosphate coatings or for coatings applied to non-ferrous fasteners and parts.

Unless otherwise agreed, representative samples from a batch of phosphate and oiled coated fasteners shall be selected in accordance with clause 7 of BS 7371 : Part 1 : 1991 and shall be tested for resistance to salt spray in accordance with BS 7479 : 1991.

The time for base metal corrosion varies according to the make and type of oil used but shall be a minimum of 24 h.

Other corrosion requirements shall be agreed between the purchaser and supplier.

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 fastener component shall assemble into a similarly threaded nut with thread of tolerance class 6H in accordance with Part 2 of BS 3643 : 1981.

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

NOTE. Phosphate coatings are unlikely to cause thread interference when applied to standard threads of pitch 0.45 and above.

7 Information to be documented and supplied to the coater

The following information to be supplied by the purchaser shall be fully documented. Both the definitive requirements specified throughout the standard and the following documented items shall be satisfied before a claim of compliance with the standard can be made and verified:

a) the number and date of this British Standard, i.e. BS 7371 : Part 9 : 1996;

b) the coating classification (see table 1);

c) the oil or subsequent treatment;

d) the hardness and property class of the component to be coated;

e) if lubrication of the coating is required in accordance with BS 7371 : Part 2 : 1993;

f) any additional information regarding limitations of the process to be used;

g) the requirement of any subsequent coating (e.g. organic coating).

8 Identification

The coating shall be identified by the number and date of this British Standard, i.e. BS 7371 : Part 9 : 1996[3)] together with the coating designation in accordance with table 1.

All phosphate coatings shall be supplied oiled unless otherwise specified by the purchaser.

Examples:

An oiled manganese phosphate coating is identified as BS 7371 : Part 9 : 1996 Type 1.

An unoiled zinc phosphate coating is identified as BS 7371 : Part 9 : 1996 Type 2 unoiled.

[3)] Marking BS 7371 : Part 9 : 1996 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 also be desirable.

Annex

Annex A (informative)

Determination of coating mass per unit area

A.1 Determination of coating mass

Degrease the group of components in an organic solvent and dry thoroughly. Determine the coating mass per unit area of phosphate using the method given in BS 5411 : Part 14 : 1982.

A.2 Calculation of coating mass per unit area

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

$$\text{Coating mass per unit area} = \frac{\text{mass of stripped coating (in g)} \times 10^4}{\text{surface area (in cm}^2\text{)}}$$

NOTE. Surface areas of common metric components are given in appendix C of BS 7371 : Part 1 : 1991.

List of references (see clause 2)

Normative references

BSI publications

BRITISH STANDARDS INSTITUTION, London

BS 3643 :	*ISO metric screw threads*
BS 3643 : Part 2 : 1981	*Specification for selected limits of size*
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 publications

BRITISH STANDARDS INSTITUTION, London

BS 1210 : 1963[4)]	*Specification for wood screws*
BS 4174 : 1972[4)]	*Specification for self-tapping screws and metallic drive screws*
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 10 : 1994	*Specification for organic coatings*
BS EN 20898 :	*Mechanical properties of fasteners*
BS EN 20898 : Part 1 : 1992	*Bolts, screws and studs*

[4)]Referred to in the introduction only.

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BSI
389 Chiswick High Road
London
W4 4AL

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